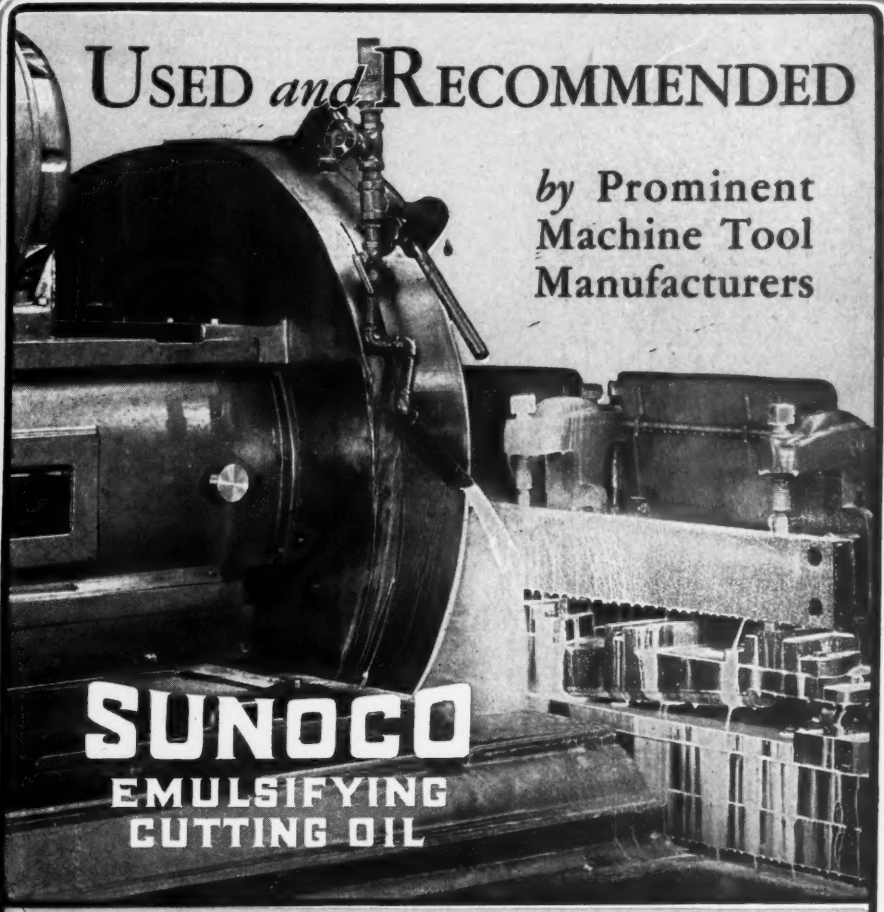
MODERN Machine Shop

June, 1932



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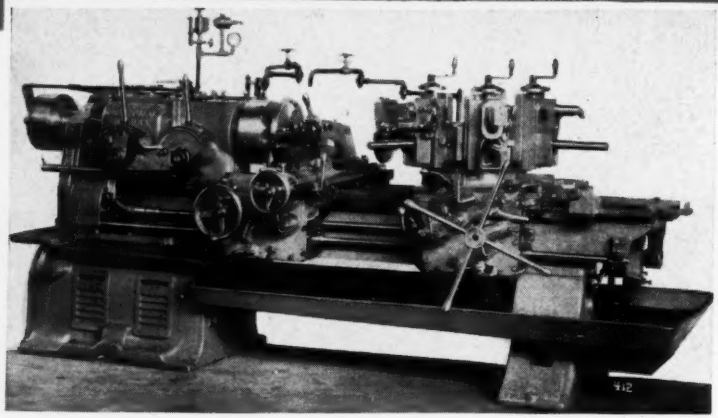

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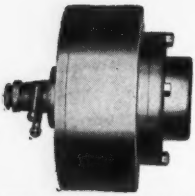

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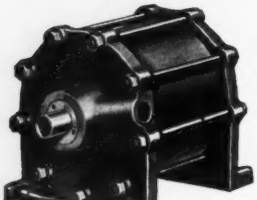

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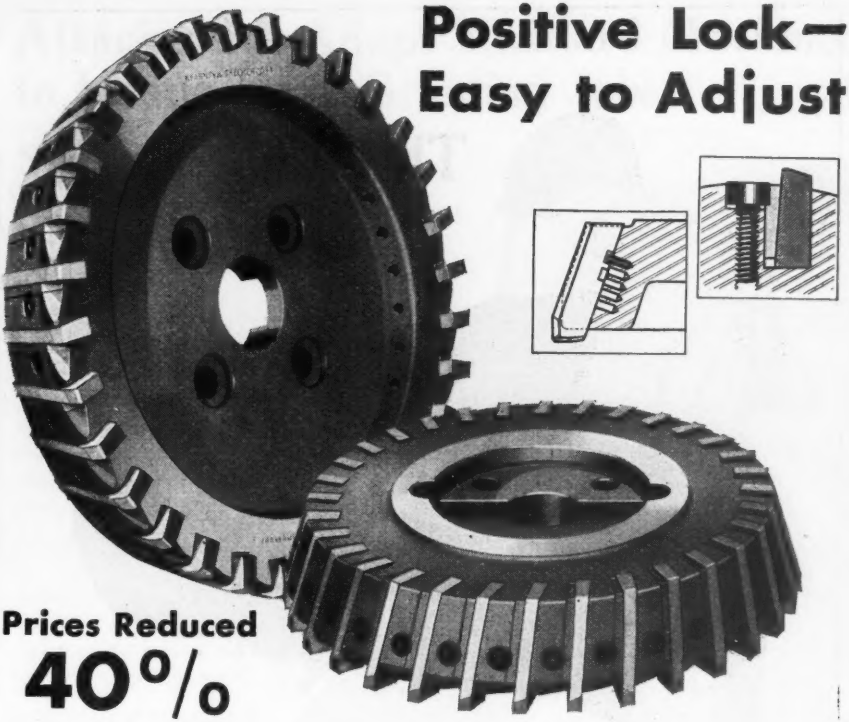

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MODERN Machine Shop

HOWARD CAMPBELL, Editor

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CONTENTS

Page

MACHINING PARTS FOR COPELAND REFRIGERATOR UNITS..... 7
By James W. Beckman

KEEPING TABS ON PURCHASES AND INVENTORIES..... 12
By Waldo Hutchinson

SYSTEM IN THE HANDLING AND GRINDING OF TOOLS..... 18

THE USE OF LEATHER BELTING IN THE TRANSMISSION OF POWER, II. 20
By Philip C. Brown, George B. Haven and George W. Swett

IDEAS FROM READERS..... 28
« « Reclaiming Two Kegs of Rivets, By Arthur H. Sandell
« « Slotting Screws in the Drill Press, By Charles Kugler
« « A Handy Center Drill Chuck, By Richard H. Kiddle
« « Cutting Turbine Blades From a Solid Casting, By A. E. Granville
« « Boring With Tungsten Carbide, By James B. Giern
« « Another Method of Making a Conveyor Screw, By T. D. Jolly

"OVER THE EDITOR'S DESK"..... 34

NEW SHOP EQUIPMENT..... 36

FOR YOUR CATALOG LIBRARY..... 52

INDEX TO ADVERTISEMENTS..... 54

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MODERN Machine Shop

CINCINNATI, OHIO — JUNE, 1932 — VOL. 5, NO. 1

Machining Parts for Copeland Refrigerating Units

Some of the more interesting of the tools and methods used are described in this article

By JAMES W. BECKMAN

THE domestic refrigerating unit has achieved an importance in the American home comparable with that of the automobile. But long after the automobile had arrived at the point where it could be considered as a success, mechanically, most refrigerating engineers still held to the opinion that a compressor of a size that would be practical for household use was impractical due to the difficulties encountered in preventing the escape of the gases under compression. The solution of this problem was found to rest largely upon the quality of the workmanship, consequently perfection has been achieved for all practical purposes and the manufacture of these units has been proceeding for some time on a production basis.

Among the better-known of the domestic refrigerating units is the Copeland, made by Copeland Products, Inc., Mount Clemens, Michigan. The speed and precision with which the parts in this unit are processed are made possible by the use of the most mod-

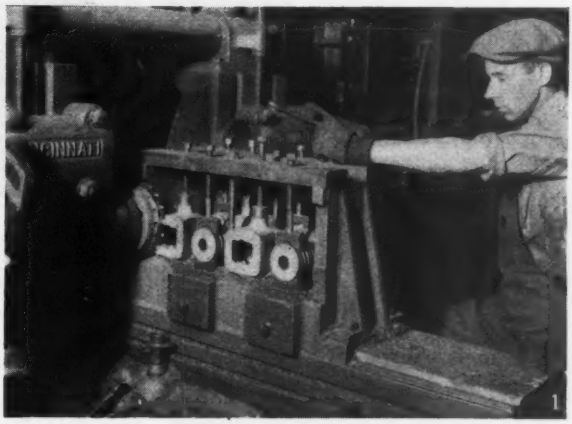


Fig. 1—Machining the ends of the cylinders.

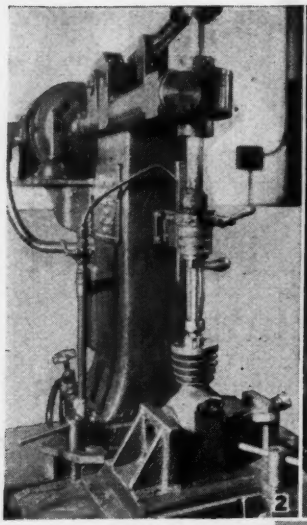
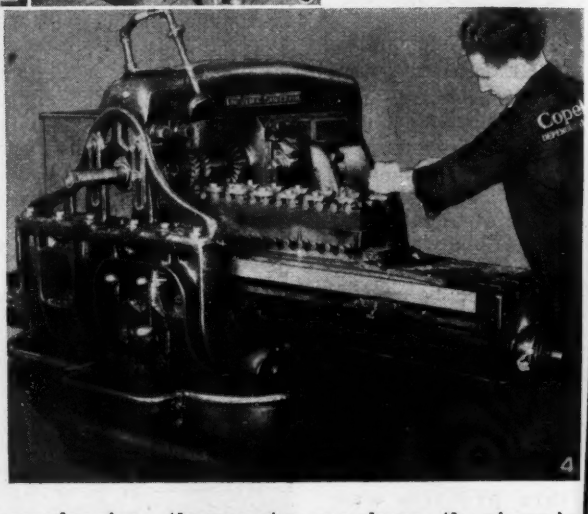


Fig. 2—The cylinder bore is honed to a glass-smooth finish with this equipment. Fig. 3—Testing the alignment of the crankshaft bearings in the cylinder. Fig. 4—Milling ends and pads on crankshafts.



ern manufacturing methods and equipment. A number of the operations are outlined in this article.

Compression is obtained by means of a cylinder, piston, and connecting rod similar to the same parts as used in a gas engine. The cylinder for the most popular size of this unit, however, has a bore of 2 in., with a piston that is 0.0015 in. smaller in diameter than the cylinder. The connecting rod for this unit is 5 in. long, and is assembled to the piston with a wrist pin that is 1-25/32 in. long and 0.4996 in. in diameter.

The cylinders are cast from a mixture of iron that cools to a very fine grain and an extreme hardness. In the first machining operation the cylinders are milled at both ends, the castings being arranged alternately in a fixture on the table of a Cincinnati miller as shown in Fig. 1. Inserted-tooth cutters with teeth of Stellite are used, running at a cutting speed of 153 ft. per minute. Two fixtures are used, one on each end of the machine table, so that the operator can change the pieces in one fixture while the set of castings in the other is in process.

The cylinders are bored with tools similar to those used in the machining of automobile engine cylinders. The bore is finished to size, however, by honing with the equipment shown in Fig. 2. The cylinder is clamped into

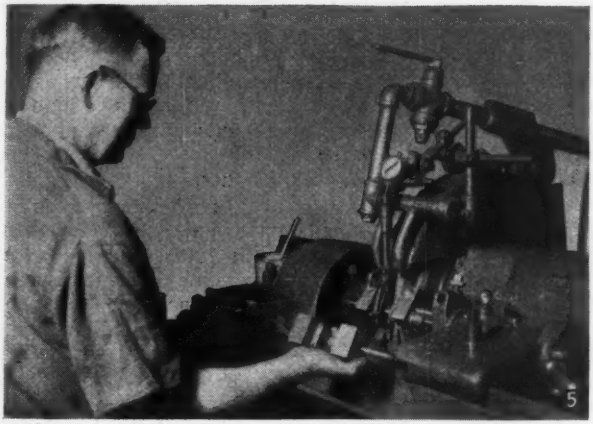


Fig. 5—Crankshaft "pins" are held to within 0.0005 in. on the grinding operation.

a fixture on the table of a vertical honing machine, as shown, and a five-stone hone is used to obtain the required finish. The hone is reciprocated vertically and revolved simultaneously at a speed of 132 reciprocations and 550 r.p.m. From 0.0015 in. to 0.002 in. of stock is removed in this manner, finishing the diameter of the bore to within 0.0002 in. of drawing size and leaving a glass-smooth finish. The diameter is gaged with a Federal inside micrometer, which is particularly adapted for such fine work. A cylinder is honed with this equipment in from 2 to 3 minutes, complete.

The operator shown in Fig. 3 is testing the alignment of the crankshaft bearings in the cylinder. To do this, he uses a hardened and ground step-arbor that is 14 in. long, inserting the arbor through the bearing holes so that it projects an equal amount on each side of the cylinder. If the bearings are within the required limits of diameter, the arbor will be a push fit in the holes.

The cylinder is placed in the inspection fixture with the ends of the arbor resting on hardened and ground blocks at each side and the base of the cylinder in contact with a vertical surface plate. The cylinder is held in this position by a plunger that is operated by means of a lever at the right of the fixture, as shown. The blocks are movable so that they can adjust themselves to the alignment of the

Fig. 6—Inspecting the surface of the "seal" on a crankshaft for a Copeland refrigerating unit.

arbor, and indicator gages show instantly the relative positions of the blocks. When the base of the cylinder is in full contact with the surface plate, the accuracy of the alignment of the bearing holes is indicated by the gages. To pass inspection, the gages must read the same within

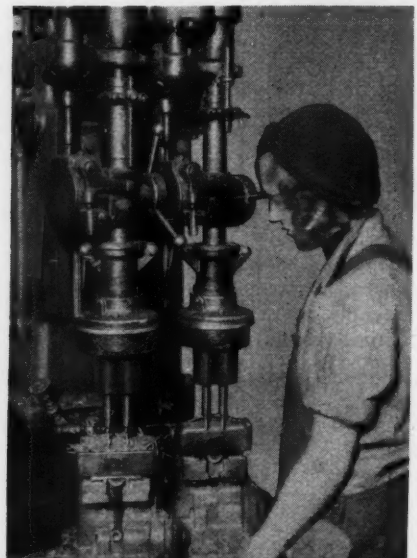


Fig. 7—Drilling bolt-holes in the connecting rods and caps.

0.001 in., which means that the bearings, being much closer together than the ends of the arbor, are in alignment within 0.0005 inch.

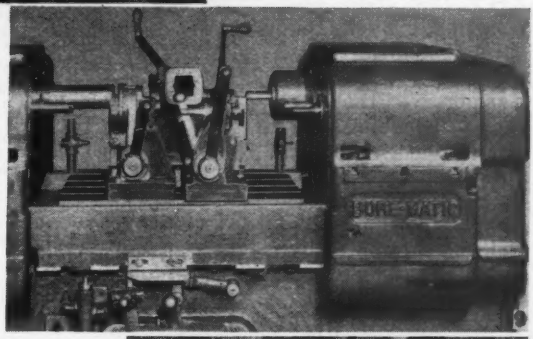
Crankshafts for the Copeland compressor are of drop forged Jalcase steel and when finished are 8$\frac{13}{16}$ in. long overall. The first machining operation on the shafts is that of milling one side of the pads and cutting the shafts to length. This operation is performed in a DeVlieg milling machine equipped with four cutters, as shown in Fig. 4. The fixture holds 14 shafts. The operator starts the machine as soon as the first four shafts have been clamped in position, finishing the loading while the machine is running, and starts to unload as soon as the finished pieces appear on the other side of the cutters. The cutters are Stellite.

Crankshafts are ground to size in the Cincinnati grinder shown in Fig. 5. To grind the pins, throw-blocks are slipped over the main bearings and aligned with the throw of the shaft, where they are clamped. The blocks carry centers upon which the shaft is swung, maintaining the center line of the pin at the correct distance from the center line of the bearings. In the illustration the operator is shown holding one of the shafts, upon which the blocks have been placed, in his hand. The pin is ground to 0.999 in. diameter, and is held to within 0.0005 in. of drawing size.

One of the shoulders on the crankshaft serves as a seal to prevent the escape of the gas with which refrigeration is obtained; consequently it must be ground and lapped to a point at which it can be "wrung" with a gage block in the same manner that two master gage blocks are wrung together. In Fig. 6 an operator is shown inspecting the surface of a seal on a shaft, for which a strong light and a magnifying glass are used. A reflecting shade is used through which a hole has been cut so that the shaft can be held under the hole and close to the light, while the operator examines the seal through the magnifying glass. If any scratches show, however slight, the seal is re-processed. If it appears perfect, the gage is "wrung" on to make sure that the seal is dead flat.

The holes for the bolts by which connecting rod caps are held to the rods are drilled with the equipment shown in Fig. 7. The machine is a two-spindle drill, equipped with two

Fig. 8—Bearings are cast in the connecting rods by the centrifugal casting process. Fig. 9—Boring connecting rod bearings to size. Fig. 10—An interesting die for forming and sealing the evaporator sleeve.

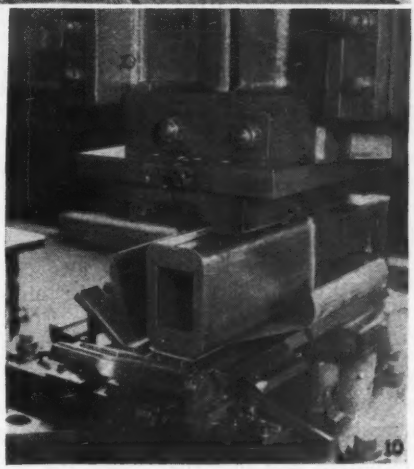


Krueger two-spindle heads and two Swartz "Quick-Clamp" fixtures. A single movement clamps or unclamps the work in the fixture, and by drilling the rod in one machine and the cap in the other, loading one machine while the other is drilling, the operator is just able to keep up with the machine.

After drilling, the rods and caps are bolted and the babbitt bearings are cast in by the centrifugal process, for which the equipment shown in Fig. 8 is used. The rod is located with the bearing in the center of the disc of the machine, where it is clamped under a round plate that has a hole through the center through which the babbitt is poured. The babbitt is poured into the bearing while the disc, carrying the rod, is rotating at a speed of 870 r.p.m. As the babbitt flows into the bearing in the rod, the centrifugal force throws the molten metal against the wall of the bearing, where it solidifies and forms a solid layer of bearing. The operator uses two fixtures, alternating and allowing the rod in one fixture to cool while he changes pieces and babbitts the rod in the other fixture.

The bearings in the connecting rods are bored to size in a Heald Bore-Matic

(*Continued on page 51*)



Keeping Tabs on Purchases and Inventories

By WALDO HUTCHINSON

AN inventory of approximately $500,000 was reported on the balance sheet of the Jones Company as of June 30, 19—. About $400,000 of this value was represented by raw materials. Very naturally this item appeared under the classification of "current assets" and it was observed that the ratio of current assets to current liabilities was healthy, from a banking standpoint. Also the working capital, as represented by the difference between the current assets and current liabilities, appeared to be ample from the classification of figures as shown on the company's statement.

1—Inventories need close examination—especially as to real availability value.

2—The relationship between inventories and other financial measuring devices should have more careful consideration, taking into account the inventory total during various periods of the year.

3—The relationship between inventories and gross sales in an evenly-balanced business should be fairly stable.

4—The statement made above also applies to the relationship between gross profits and inventories.

5—Good management warrants the adoption of inventory and purchasing control methods that will furnish comparative records by which the state of the balance can be measured.

This statement was presented to the company's bankers with a request for an extended line of short-term credit. The moneys applied for were to be used to convert the raw material inventory into finished goods. Orders on hand indicated a favorable condition. From the information submitted it would appear, at first glance, that the loan was warranted.

A detailed investigation of the inventory brought to light a peculiar situation and one that upset the inclusion of the major part of this inventory value in current assets, and hence working capital. The raw material was divided into nine major groups. Of one group there was available sufficient material to manufacture corresponding parts for some 8,000 product units. This was one extreme.

The other extreme consisted of an item of a group of raw material sufficient to manufacture corresponding parts for but 800 completed units. Therefore, in order to make available for completed product manufacturing all of the material of the first group, it would be necessary to purchase additional material of the second group for 7,200 units. The quantities of the other seven groups fell somewhere between the two groups mentioned. It was calculated that in order to make 20 per cent of the value of the raw material inventory of $400,000 available for conversion into finished product, an additional expenditure of some $40,000 for raw material would be necessary, and that in order to make 80 per cent of the value of the raw material inventory available, pur-

chases totaling some $300,000 would be necessary.

It was very obvious, therefore, that but a small part of the inventory in its unbalanced condition could be correctly classified as a "current asset" and that the financial needs of the company for the conversion of its inventory were far greater than had been anticipated. The apparent healthy condition of the company, as reflected by the balance sheet statement, was changed to indicate a rather weak and uncertain position. It was of interest to determine the reason for this condition.

Upon investigation it was found that, about a year previous, the purchasing agent was offered a "price bargain" in this over-purchased item, and purchased all that was available. For a number of years practically all inventory items were drastically unbalanced because of the general policy of the purchasing department to buy at any time in practically any quantity if "price bargains" were found, and almost entirely without regard to production requirements.

In connection with examinations made for the purpose of determining the value of proposed financial issues or whether or not large commercial loans or extensions of credit are warranted, one of the many items critically examined is the inventory.

The Smith Company, a leader in its industrial field, prided itself upon its highly developed and statistical control methods. The information gathered and the effective use made of this information were remarkable. The company operated on a quarterly schedule basis. The sales department made an elaborate analysis of the market possibilities for the approaching period. Sales quotas were set and every inducement was given the salesmen to meet their quotas. From these quotas a master schedule of manufacturing requirements was developed and submitted to the production department as a basis for planning the next period's production. The production department in turn analyzed the material requirements and prepared purchase requests, in each case specifying the date when needed. These were submitted to the purchasing department. The purchasing department was highly organized from a system standpoint. The dominating slogan was "Purchase Goods at the Lowest Prices." Hence, on every item of a cost of more than $500, requests for bids were mailed to as many sources as could be found.

The writer became interested in the machine record charts of this organization. These charts graphically indicated the planned operating hours of each machine tool and the actual hours. The reason for idle machine time was indicated by various symbols. One department showed an unusual amount of idle machine time, the reason for which was indicated as "waiting for materials." It was also found that several other departments were seriously affected by the idleness of this department. The cause was traced to the purchasing department and the reason for the absence of the needed item of raw material was discovered.

It appeared that on this item of raw material requests for prices were sent to a large number of sources, many of which were new. There was nothing unusual about this; it was part of the recognized routine, especially since the quarterly requirement for this item was valued at about $50,000. The quoted prices from the various sources did not fluctuate to any great extent; the lowest, however, was some 5 per cent below that of a former supplier. In accordance with routine, the entire order was placed with the lowest bidder at an apparent

saving of about $2,500. The usual promise of prompt deliveries according to stipulated requirements was made by this supplier; the same as the others. The supplier indicated, however, was a new organization and not prepared to handle an order of this size during the allotted time period.

In order to aid the situation, a frantic search was made for small lots available for immediate delivery, with the result that limited quantities were obtained at a substantially higher unit price and at express rate charges in place of freight rates. Records indicated that losses due to idle equipment and delays of completed assemblies were in excess of $1,500 and it was estimated that an equal amount would probably be lost before the situation was brought to a balanced condition. This occurrence brought very forcibly to the attention of the purchasers that other factors besides "lowest prices" were of importance in purchasing and that no system alone will at all times give satisfactory results. It must be used with common sense.

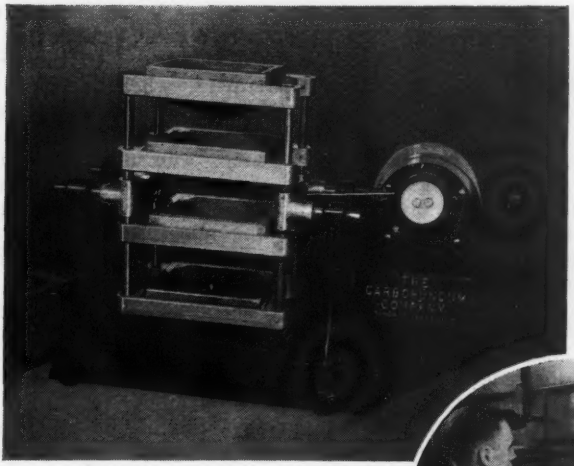
Manufacturing has been described as a process which increases the economic value of materials by the application of human, mechanical, or chemical energies or forces. Theoretically, therefore, a manufacturing enterprise should obtain its profit as a result of this increased value rather than through any market rise in the value of the raw material. In practice, however, during periods of increasing prices, many industrials profit also by this rise in value of their raw material stocks.

Occasionally one finds manufacturing enterprises whose major profit, and at times all of their profit, is made from appreciation of inventories and "futures." This method becomes more prevalent during periods of rapidly increasing commodity prices. In such cases the manufacturer, in reality, becomes a broker or a speculator of the material market.

The Brown Manufacturing Company produced what is termed an assembled product; that is, about 80 per cent of the parts in the completed unit were so-called standard parts and purchased complete from outside sources. The production of a new model was planned, and in order to cope with the competitive market situation, a cost limit was placed on these parts. The engineering department prepared complete specifications for these parts, and on some of the more important parts it actually stipulated the source. On one unit a difference of $40 each in the price of two manufacturers was discovered. The one specified by the engineering department was the higher.

From a layman's point of view there appeared little or no difference in the two types, so the purchasing department, without further consultation with the engineering department, contracted for the purchase of 1,000 of the lower-priced units at an apparent saving of $40 each. To the dismay of the purchasing agent, it was discovered that, although this lower-priced unit could be readily used, changes in designs of other parts were made necessary at an increase in cost of some $95. Hence, an apparent saving of $40 in reality increased the cost of the completed product some fifty-five dollars.

Where close co-operation is lacking between those who specify and those who procure, cases like the above are not infrequent, especially where the items are of a somewhat technical nature. In the examination of inventories one frequently finds items of considerable value classified as obsolete because, when delivered, they agreed with the purchasing agent's



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orders, but were not adaptable to the needs. Sometimes returns to the source were difficult, and the loss was mitigated by a happy optimism that at some future time use could be made of these items.

Most companies are lethargic as regards efforts to dispose of non-usable items, hence an error such as outlined above usually results in a substantial loss. Purchasing is but one of many functions in the cycle of business, but its effect on other functions and activities is far-reaching. The purchasing department comes in direct contact with the engineering department, or specifications department, for specifications; with the production department for quantities and time of deliveries; with the receiving and inspection department on quality and quantity verifications; with the traffic department on routing and tracing of incoming shipments; with the auditing department on verification of prices and terms; and with the stores department on disposals of obsolete or unusable material.

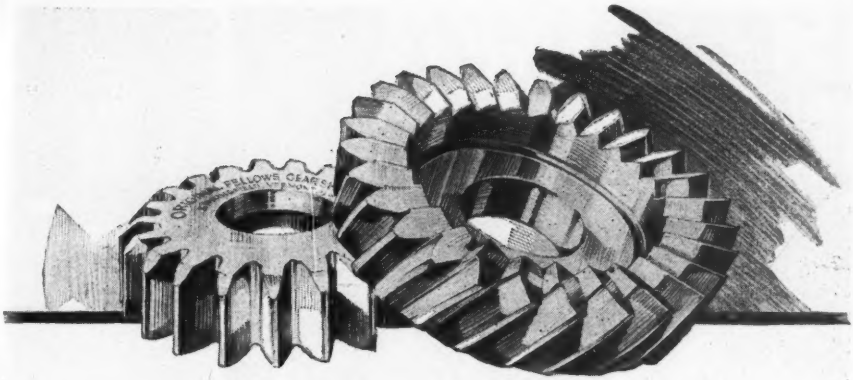
Industrial managers have begun to realize that a large percentage of the waste in industry is caused by the lack of effective co-ordination and control plans for the business as a whole. The tendency now is to work on a basis of carefully planned schedules. Naturally, production material requirements should be based on the market condition of the product, and these requirements should be determined well in advance, so that the production and purchasing departments will have ample time to prepare for the fulfillment of their schedules. The starting point for these schedules is in the sales department, where a careful analysis of the sales possibilities for the subsequent period is made and the sales quotas are set.

The length of these periods depends upon the distribution and manufacturing conditions of the industry, and may vary in length from one month to a year. This sales schedule is then submitted to the production department, where preparations are made for the manufacturing of the specified number of units in the specified time. The material requirements for this production program are determined and purchase requests written for any necessary additions of materials, together with a time schedule as to deliveries. This method will insure against overpurchasing and against unbalanced conditions of inventories, for should the sales department fall somewhat short of its predictions, a new balance is obtained at the beginning of the next period. These schedules are prepared far enough in advance to give the purchasing department ample time to obtain quotations, examine the reliability of its sources as to quality and delivery dependability, and place its orders.

In order to accomplish its part of the program effectively, the purchasing department must be well organized internally as to personnel, information, records, and systems. One of the most essential of such records under this plan is the "following record." This record, either in written or graphic form, should indicate, among other things, the schedule date of what is needed and, compared with this, the exact status of the order on a time basis; that is, date of placement, date of acknowledgment, promised shipping date, actual shipping date, traffic follow-up, and so on.

A great deal of experience as to correct and incorrect inventory situations has been gained by bankers and industrial managers during the period of depression. Inventories will be examined much closer in the future, especially the real "availability" value of the inventory. The relationship between inventories and other fi-

(*Continued on page 50*)



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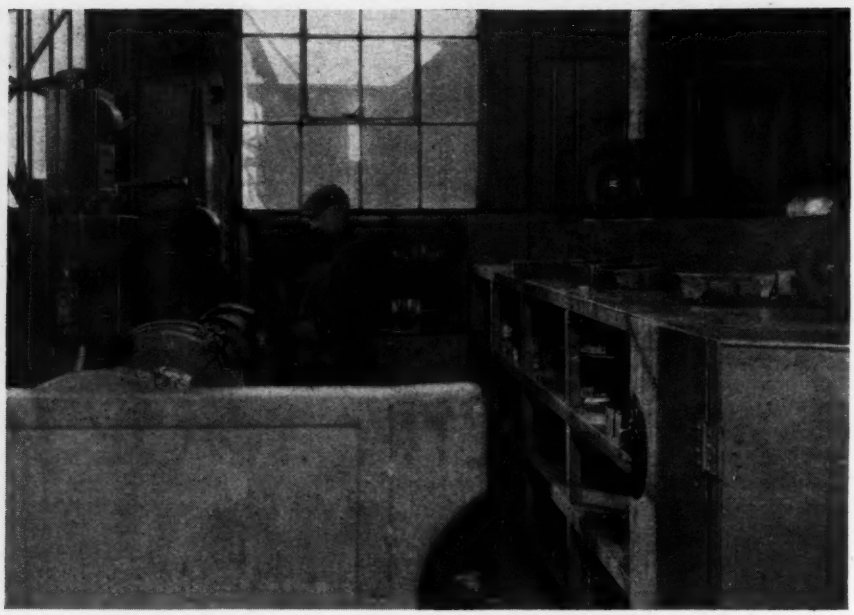

System in the Handling and Grinding of Tools

THE illustration shows one of the several tool-grinding cribs that have been erected in the shops of the Norfolk & Western Railway at Portsmouth, Ohio. The crib shown is located in the wheel shop.

There are always certain machine tools with which heavy cutting tools are used, usually of the forged type. The grinding of such tools is a considerable task in itself, and if it is left to the machine operator to grind his own tools, he must necessarily spend a large part of his time at the grinding wheel and away from his machine. The loss in production and cost of an expensive machine standing in idleness is obvious. In addition to this, the operator will grind his tools according to his own ideas, which may be far from perfect.

The crib shown serves a certain number of machines, each of which is provided with two sets of tools. One set is at the machine; the other set is at the crib. When a sharp tool is required, the machine operator turns in his dull tool, receiving for it a duplicate that has been freshly ground. The one man in the crib is especially trained for this task, and knows exactly what the rakes, angles, and clearances should be on each type of tool. Some of the tools are ground to special gages, one of which is shown on the top of the counter in the illustration.

This method of handling tools insures that the machines will be kept in operation as much of the time as possible, and also insures that sharp, correctly-ground tools will be available at all times.

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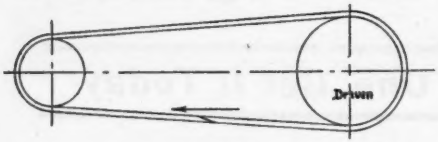
The Use of Leather Belting in the Transmission of Power, II

In this, the second article of the series, the authors tell how to use and maintain belt-driven equipment.

By PHILIP C. BROWN, GEORGE B. HAVEN, AND GEORGE W. SWETT *

IN THE preceding article we have determined for the purpose of this discussion that a motorized group drive equipment has been decided upon as the logical economic and engineering installation. The next question is how to use and maintain it. In the first case, when trouble develops, the belt should be blamed last and not first. The engineering requirements in the successful use of leather belt are just as rigid and necessary as in any branch of science.



Pair of pulleys connected by open single belt, showing proper direction of over-lap in joint.

The Belt. Flat flexible bands, or belts, running on pulleys have long served as one of the simplest means of power transmission. Under modern industrial conditions, belting still holds a very important place in this field. Among the advantages claimed for this system are:

(1) Simplicity of the elements involved.

(2) Economy of installation and maintenance.

(3) Reliability.

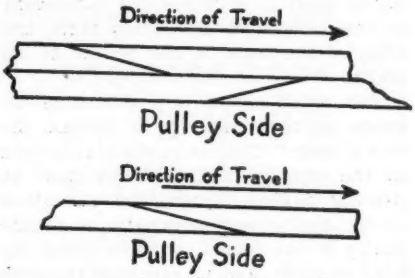
(4) Ability to carry sharp peak loads.

(5) A safety device in cases of heavy overloads. Of the materials used in such belts, leather holds a leading position due to the fact that it has numerous qualities which make it admirably suited for this purpose. When care is taken to select a leather belt suitable for the conditions imposed in any specific drive, efficiency, economy and long life with a minimum of attention will result.

When practicable, belts should be made endless by lapping and cementing. Such belts will run truer and last longer with fewer stops for repairs. Particularly is this true of wide belts, belts running at high speed where any type of fastener is objectionable, and belts running over small pulleys. Using belt clamps, a good grade of cement, and belts with adequate laps and squared ends, the joint should be no weaker than other portions of the belt. If some type of belt fastener is to be used it should be flexible, not too heavy, and should not unduly weaken the belt at the point where it is attached. Stiff metal fasteners are not desirable. Hinged metal fastenings or rawhide lacing

* George B. Haven is Professor of Advanced Machine Design and George W. Swett is Professor of Machine Design, both of Massachusetts Institute of Technology. Philip C. Brown is President of I. B. Williams & Sons, and Chairman of the Engineering Commission of the American Leather Belting Association.

with strands on the pulley side running parallel with the belt edge make satisfactory connections for belts of moderate speeds and powers.



Sections of double and single belts showing position of over-laps in the plies.

In selecting a belt, care should be taken not to select one which is much too heavy for the power it is to transmit, as such belts will weave to and fro and will not run in a satisfactory manner.

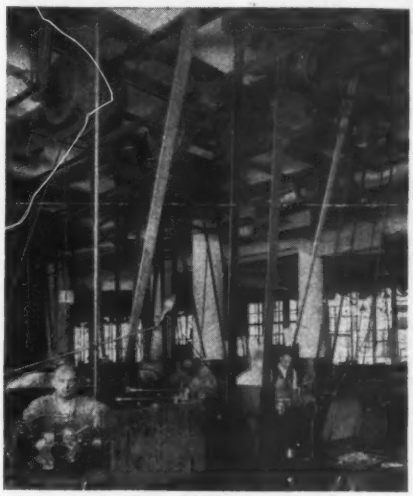
The Pulley — The proper selection and design of the pulleys with shafting and hangers has much to do with a satisfactory power distribution system. Pulleys are usually made of cast iron, fabricated steel, paper, or various kinds of wood. Pulleys may be solid or split and in either case the hub may be split for clamping to the shaft. Double belts require heavier pulleys than do single belts. For rim speeds in excess of 4,000 ft. per min., special care is necessary in securing a correct running balance. Such pulleys are necessarily subject to extra cost.

In the selection of pulleys, consideration should be given to rim speeds. The motor manufacturers equip their motors with standard pulley sizes designed to give belt speeds between 3,500 to 4,500 ft. per min. This figure represents the best of engineering practice. The balance of the shop installation can well follow this example where possible.

The reasons are simple and elemental.

Power is a product of force and a rate of speed. The faster a belt travels, the less effective are the tensions required to transmit a given horse power. The limit of this argument is determined by centrifugal force at a speed of about 4,500 feet per minute.

Since high speeds mean lower tensions, they also mean lighter or narrower belts and less bearing pressures. These factors may make a tremendous difference in the life and efficiency of the equipment. Unfortunately, in the past many machine manufacturers have equipped their apparatus with pulleys that were too small. They had two reasons—reduction of cost of manufacture and an appearance of low power requirements. The latter factor has often been a



Well-arranged group drive with modern hangers, ball and roller bearings, and so on.

snare and a delusion very costly to the user. In general, then, larger diameter pulleys are preferable where their use is feasible.

Pulley face widths are nominally the same as the width of the belt they are to carry. Actually, however, the pulley face should be approximately one inch more than the belt width for belts under 12 in. wide, two inches for belts from 12 to 24 in. wide, and three inches for belts over 24 in. in width.

Belts may be made to center themselves on their pulleys by the use of crowned pulleys. Flanges on the sides

Rockwood short center drive, ceiling mounting. 10 h.p., 1800 r.p.m. motor drives lineshaft through 5-in. belt on 5-in. driving and 34-in. driven pulleys. Shaft centers, 42 in.

of the pulleys are in general very undesirable and unnecessary, since the belt tends to crawl against them. Belts running on such pulleys may have their edges injured or may ride the flange, if the belt is loose and the flange poorly designed. In general, if the pulleys are properly crowned, they will retain their belts in correct central position without other means.

Crowned pulleys may have a rim section either with a convex curve, or a very flat V-form. While the straight crown is the easier to construct, it is somewhat more liable to injure the belt, especially if excessive. Also straight crowning tends to load and strain the belt at the center while the other portions may not secure, with stiff belts, a very good degree of contact. A usual figure for the amount of crowning is ⅛ in. per ft. of pulley width, which is equivalent to the usual rule that the crowning should be 1-96 of the pulley width. The term crowning is used to indicate the increment in the radius of the pulley from the edge of the face to the center of its width.

Too much crown is undesirable because of the tendency to "break the belt's back." This is particularly true in the case of riding idlers close to driving pulleys, where the curvature of the belt changes rapidly from one pulley to the other. In such cases the idler should under no circumstances be crowned and the adjacent pulley should have very little crown. Pulleys carrying shifting belts are not crowned. Tight and loose pulleys may be of the same size, or the loose pulley may be made somewhat smaller in diameter to relieve the belt tension when running idle. In this case the idle pulley should be slightly wider with an extra rising tapered edge leading the belt from the loose to the tight pulley when the shifter is thrown for that purpose.

In the interest of belt economy, when possible, shafts running at slow speeds should carry reasonably large pulleys to give a high belt speed. Pulleys of small diameter with consequent severe belt flexure as well as heavy belts at very low speed are undesirable items in industrial equipment.

For the successful distribution of power by belts, it is essential that the shafting, bearings and hangers shall be correctly designed and carefully erected. Shafts which deflect unduly, bearings that are too small, and hangers that are out of line are the sources of great power losses.

The Belt and Pulley.—The practice of running the grain side of single belts next to the pulley is almost universal in this country. In Europe

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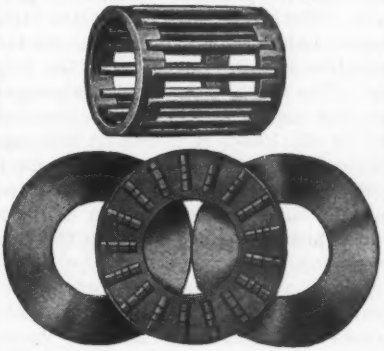

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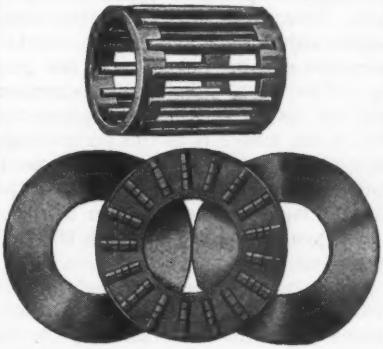

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the opposite practice frequently prevails. The grain side has better frictional value, however, and should therefore run in contact with the pulley. The flesh side is the stronger and not as liable to crack when the belt is old, hence it is run on the outside where the tension is greatest. Single belts should be run with the outside lap edge pointing in a direction opposite to that in which the belt is moving.

The minimum diameters of pulleys over which belts of various thicknesses will run satisfactorily varies with the care used in the manufacture of the belt. Good practice is represented in the following table:

Minimum Pulley Diameter for Various Belt Thicknesses

Type of Belt	Thickness Ins.	Min. Pulley Diameter Ins.
Light Single	1/8 to 5/32	3
Medium Single ..	5/32 to 3/16	4
Heavy Single	3/16 to 7/32	5
Light Double	1/4 to 9/32	6
Medium Double ..	5/16	10
Heavy Double ...	3/8	16
Medium Three Ply	1/2	30
Heavy Three Ply.	9/16	36

Practical Rules.—For small and relatively unimportant drives it is rarely necessary to employ the theory of belting in order to determine the necessary width of belt. Simple arithmetical rules can generally be used in such cases and will give a fairly good margin of safety in the use of the belt. Such rules generally embody simply the horse power to be transmitted and the velocity of the belt. They are called "Millwright's Rules," and may be stated as follows:

1. A single leather belt traveling 800 ft. per min. will transmit one horse power per inch of width.

2. A double leather belt traveling 500 ft. per min. will transmit one horse power per inch of width.

These rules do not take into account the centrifugal force of the belt, but merely consider a double belt 1.6 times as effective as a single belt. As has been shown heretofore, there is considerable latitude in the use of the terms "single" and "double" as applied to belting. However, the above rules are applied to the average single and double belt and give wide margins of safety in the transmissive power when the velocity of the belt is not over 4,000 feet per min. As will be shown in a subsequent chapter, at a speed of about 4,000 feet per min. the centrifugal effects due to the belt weight begin to manifest themselves in an important manner. Therefore, for heavy transmissions and high speed belts the simple rules adduced above should be checked by a competent engineer or manufacturer.

Installation, Care, and Specifications.—The success of a belt drive depends very largely upon a suitable selection of belt, and proper installation and care. For a given cross-section, narrow thick belts are to be preferred to wide thin ones; that is, a light double belt rather than a wider single is more economical if the pulleys permit its use. Single belts over eight inches wide should not be used. The narrower belts may be run on narrower pulleys—a distinct advantage in cases of overhung pulleys—and stepped pulleys. Furthermore, narrower belts, especially if light doubles, run truer, stretch less and shift easier.

Belt drives located in acid fumes where temperatures above 120 deg. F. and high humidities prevail, or those installed in air charged with dust and grit, must be carefully selected and specially treated.

Care must be taken in aligning shafting, as pulleys out of line cause an unevenness of strain across the belt, and, where flanged or stepped pulleys are used, there is danger of injury to the belt edge.

The tension with which a belt is

placed upon the pulleys is very important and for maximum service it should be neither too tight or too loose. If too tight, there is excessive belt stretch, and the bearing loads will be too heavy, with consequent power losses and heating tendency. If too loose, the belt will slip, thereby injuring the belt and reducing the power which the belt is capable of transmitting.

Laced belts should have their ends cut square and evenly butted together. The lacing should be drawn equally tight, to prevent an uneven strain with a tendency to cause the belt to run crooked.

Belts should be installed when possible with the slack side on top for all horizontal or inclined drives. Vertical drives, unless absolutely necessary, should be avoided.

Care of Belts.—Leather belts should be periodically inspected. Any accumulation of dust, dirt or grease should be removed and a clean surface restored. Mineral oil injures leather and should be prevented from penetrating the belt by removing with gasoline. If the belt becomes hard and dry, an application of neatsfoot oil, or a proper belt dressing consisting of a compound of cod liver oil and beef tallow, may be used to soften the surface. Rosin or compounds containing rosin should not be used. Commercial castor oil is dangerous as it is liable to break down and release acids. Difficulties in power transmission should be remedied by the use of a wider belt, by suitable belt tension, or by the use of an approved type of belt dressing. Belts should be inspected periodically for loosened laps, as a lap once started rapidly fails.

Estimates and Recommendations.—For the preparation of estimates and recommendations for a belt drive the following information should be supplied:

(a) Horse power to be transmitted.
(b) Fluctuations of power requirements.
(c) Sizes of both pulleys.
(d) Speed of one pulley, stating which one.
(e) Distance on centers.

Group drive in press room, with relatively few machines to a group. A saving is effected here in total connected load increase over power demand.

(f) Belt open or crossed.
(g) Type and position of idlers, if any.
(h) Inclination of drive.
(i) Location of slack side, top or bottom.
(j) Use of flanged or stepped pulleys.
(k) Use of belt shipper, if belt is shifting.
(l) Unusual conditions, as
  (1) Acid fumes.
  (2) Grit or dust in air.
  (3) High temperature.
  (4) Dampness.
  (5) Angular drive.

Ordering Belts.—When belts are to be slipped over pulleys, endless (that is, in a continuous loop), care must be taken in ordering from the manufacturer to specify "endless" or "made endless." The manufacturer will then cement the ends together, making a continuous loop, or "endless" belt. When the belt is to be threaded over the pulleys first and made endless afterwards, the ends should be prepared but not cemented together. In such case order "prepared for endless."

Measuring For the Belt.—Measure with steel tape around the pulleys (if necessary to measure over the old belt, deduct from the tape line length six (6) times the thickness of the belt); or figure the length from the diameters and center distances of the pulleys. Tape line measurement is always the safest and best.

Use plenty of belt. It is poor economy to be forced to make a belt unduly tight or smear it with sticky belt dressing to make it carry the load. These conditions waste power and shorten the life of the belt.

Allowance For Stretch. — Leather belts, being elastic, will let out somewhat when put under driving tension, hence it is necessary to make allowance for this in cutting off the belt. The general rule, and usual practice, is to cut the belt ⅛ in. per ft. short of the steel tape line measurements. For example, a belt for a drive 16 ft. long (tape line measurement) would be cut 15 ft. 10 in. long.

When ordering a belt, always give the full tape line measurement to avoid double allowance for stretch, as the manufacturers are accustomed to make allowance for this initial let-out when cutting off belts to measurements for particular drives.

In this article we have attempted to give the high spots only in the application, use and maintenance of leather belting to motorized group drive installations. The "Treatise on Leather Belting" has been abstracted freely and we also want to suggest that leather belting manufacturers are always glad to co-operate in any engineering question as to the application, use, or maintenance of leather belt.

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The R. Y. Ferner Co., Investment Bldg., Washington, D. C., has issued Catalog No. H-1, describing two types of portable hardness testing instruments that have been placed on the market by this firm. One of the instruments is a pendulum type tester, called the Duroskop, which is not only adapted to the testing of metals, but also to such materials as ceramics, rubber, plastic and vulcanized products, linoleum, and so on. The second is a Dwarf Brinell Press that can be used in any part of the shop where a vise, arbor press, drilling machine, or large C-clamp is available with which to apply pressure. This outfit includes a unique magnifying glass for reading the diameters and Brinell numbers of the impressions in the pieces tested. Copy free upon request.

Williams Issues Complete Catalog

J. H. Williams & Co., 75 Spring Street, New York, N. Y., have announced that the new twenty-first edition of their complete catalog is now ready for distribution. This 216-page volume includes all of the recent additions to the Williams line of drop forgings and drop forged tools, among which are their line of "Supersocket" wrenches, the improved "Vulcan Superior" chain pipe tongs, and many improvements incorporated in their standard product. Copies may be had by addressing the firm as above.

Shafer Roller Bearing Bulletin No. 501

Bulletin No. 501, issued by Shafer Bearing Corporation, 619 South Kolmar Avenue, Chicago, Ill., lists all the latest sizes of Shafer Roller Bearings (both single and double row), together with complete dimensions and list prices. A speed factor table for figuring intermittent speeds is included. Copy free upon request.

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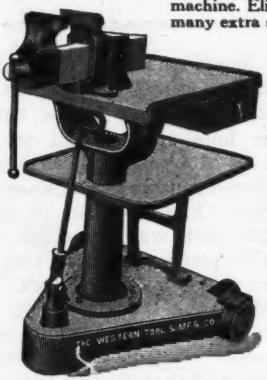

This movable bench embodies a large base with ample weight. Rear wheels have brakes. With handle pulled forward, front wheel is operable and brakes are released from rear wheels.

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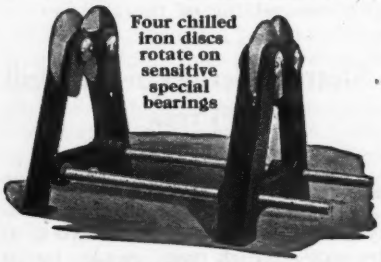

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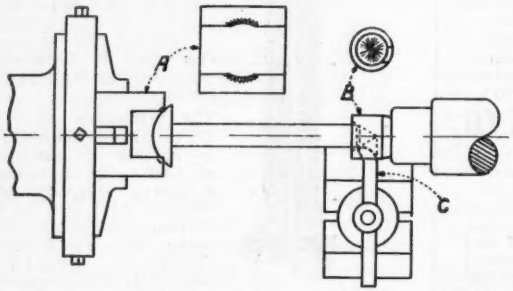
Reclaiming Two Kegs of Rivets

By ARTHUR H. SANDELL

DUE to an error, two kegs of rivets were ordered that were $\frac{1}{16}$ in. too large in diameter. The rivets were to be used in the construction of a link belt, the links for which had been made and hardened. Consequently the links could not be drilled larger, and if the rivets were to be used, it was necessary that they be machined to a smaller size.



Drawing showing design of tools used in turning rivets.

The rivets were 2½ inches long and $\frac{7}{8}$ in. in diameter. At first thought it was considered cheaper to scrap them than to try to machine them, but with a little thought a device was designed with which the rivets were turned at a cost that surprised the cost department.

A square block of tool steel was milled out to leave two opposing edges which were bored slightly to conform to the radius of the rivet heads, then teeth were filed in the edges as shown at **A**. The block was then hardened and chucked in a four-jaw chuck on a lathe. A taper shank to fit the tailstock center hole was turned on a round piece of stock **B**, and a taper hole was bored in the large end, slightly larger than the end of the rivet. A wide slot was then cut in the side of this piece to provide clearance for the turning tool.

With the lathe running, a rivet could be placed in the female center in the tailstock and then forced against the teeth in the block in the chuck. The teeth would "bite" into the metal enough to drive the rivet while the turning tool was cutting and at the same time would release the piece immediately when pressure was removed. The clearance slot in the side of the tailstock center made it possible to turn the entire length of the rivet. The lathe was kept running during the entire operation, and the two kegs of rivets were turned with one setting of the tool.

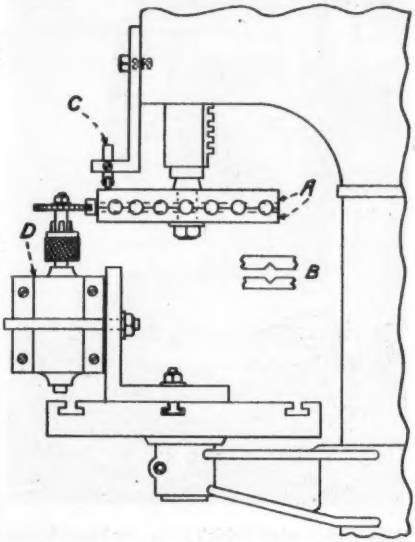
Slotting Screws in the Drill Press

By CHARLES KUGLER

SCREW-HEADS and other similar parts can economically be slotted by the use of the fixture shown in the drawing, which was made by the writer. The fixture is attached to an arbor which is inserted into the spindle of a drill press, and the slotting

is performed with a cutter that is operated by means of a portable electric drill.

The fixture consists of two heavy discs **A**, in which V-shaped grooves



Drill press equipped with fixture and electrically-operated saw for slotting screw-heads.

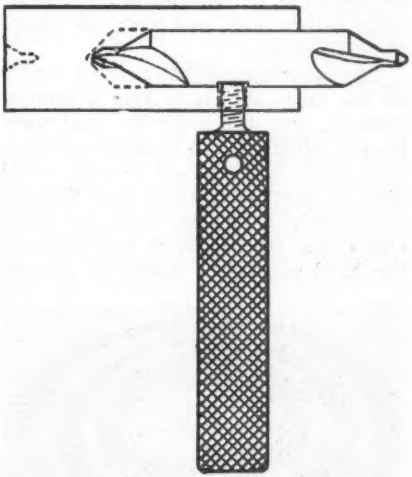
are milled radially as shown at **B**. The discs are spread far enough apart on the arbor so that the screws to be slotted can easily be inserted into the grooves, and the upper disc is loosely fitted to the arbor so that it can be tilted slightly. A small block carrying a roller **C** is anchored to the machine in such position that it bears on the upper disc at the front of the machine and thus clamps the bolts in that side of the fixture, at the same time releasing those in the opposite side of the fixture. Thus the operator is enabled to load and unload the fixture while the machine is in operation.

The electric drill **D**, carrying the milling cutter, is clamped to an angle plate that is bolted to the table of the machine, the table being adjusted so that the saw will cut to the required depth. The fixture and saw should be run in opposite directions. If the screw-slots in the fixture are located closely enough together, it is evident that the slotting will be almost continuous.

A Handy Center Drill Chuck

By RICHARD H. KIDDLE

THE tool shown in the drawing will come in handy when a piece of work is to be centered and all the small drill chucks are found to be in use. The drill is a standard stock center drill, and the holder is made from a piece of cold rolled steel. The holder can be made any size and any length desired, although the drawing dimensions were taken from a holder that was 2¼ in. long and ¾ in. in diameter. One end of the piece of stock is drilled and reamed or bored to a sliding fit for the center drill, and the opposite end is centered so



Drawing of Center Drill Holder, with Drill.

that it can be located on the tailstock center of the lathe. A hole is drilled and tapped in one side to take the

threaded end of a knurled handle which serves the double purpose of locking the drill in the holder and providing a handle by which the tool can be held while in use.

Before inserting the center drill into the holder, it is flattened on one side to afford a seat for the threaded end of the handle, as shown. Having started the center hole with a flat drill, as usual, the holder is located on the tailstock center and held with one hand while the other hand is used to feed the tailstock, carrying the drill into the work.

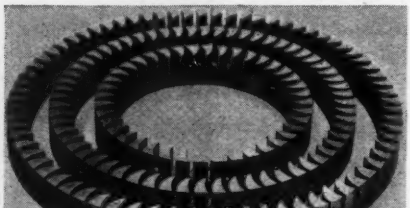
Cutting Turbine Blades From a Solid Casting

By A. E. GRANVILLE

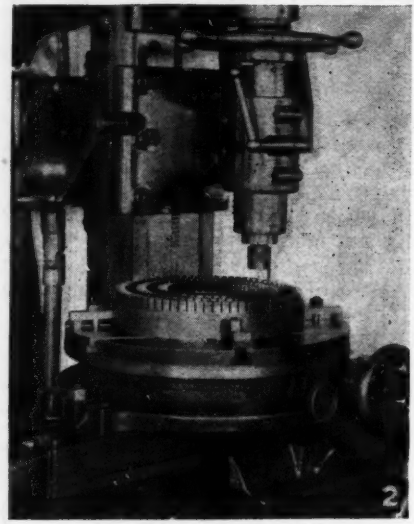
AN experimental shop or any other shop in which a variety of general machine work is done is often required to stretch its resources to the limit in order to produce odd pieces of work in a reasonable length of time, at low cost, and with the equipment available.

The machining of the turbine blades on the piece shown in Fig. 1 seemed difficult, yet the solution was very simple after it had been discovered. The piece was turned from a solid disc of cast iron, as it was thought inadvisable to try to mold the three concentric rings. This was because the hard scale that would be formed on the casting might not be even and might cause too much springing of the tool in finishing.

The disc was cast large enough so that it could be machined all over. To machine, the disc was chucked in the lathe and faced on one side and half of the periphery was turned, then it was reversed and the opposite side was faced and the remainder of the periphery turned. The three concentric rings were then turned in one side of the disc and the job was ready for the blade-cutting operation.



Turbine blades milled from a solid casting.



Equipment with which the turbine blades were milled.

The blades were milled in with a Brown & Sharpe vertical miller, using a single-blade end-milling fly cutter, as shown in Fig. 2. The work was held on a rotary feed table which was used, however, only for spacing the blades, the angular settings being obtained by shifting the table as necessary. The cutter was fed straight down, circling three blades in milling the outside contour of the blades and circling two blades in milling the in-

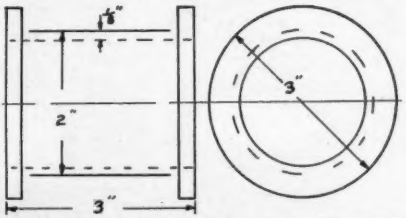
side contour. This method of working made it possible for the cutter to clear the blades in making the complete circle. The same radius, but a different center, was used in machining the two contours.

Boring With Tungsten Carbide

By JAMES B. GIERN

EXCESSIVE heating in the process of a boring operation indicates that the tool is dull, and a dull tool usually results in difficulties as to size and finish. Boring is practically always a more difficult operation than turning, and is more difficult to repair in case of error. The writer has, however, found that a large part of the usual difficulties of boring may be eliminated by the use of boring tools of tungsten carbide. Tungsten carbide tools make possible increased speeds, with fewer changes of tools.

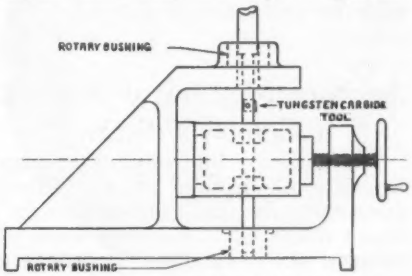
In using carbide tools for boring, the design or construction of the machine to be used is not as important as the design of the fixture and cutting tools, although it is important that the proper speeds be available.



Design of cast iron bushing with thin walls.

The machine is simply the driver, the accuracy with which the operation is performed being dependent upon the design of the tools and the accuracy with which they are made. This point may be illustrated by a few examples.

Figure 1 shows the design of a small gray iron casting with extremely thin walls. The boring of this casting would ordinarily necessitate a core drilling operation first, then semi-finish reaming, and finally finish reaming. It is clear to the experienced mechanic that unless the tools are kept to perfect



Cross section drawing of tools for boring cross-hole in piston.

sharpness, each operation in turn would tend to bulge the thin walls of the piece, and the heat generated would be excessive. By using the proper tools, the task can be performed in two operations and the piece will be no more than warm when removed from the fixture. The experience of the writer has been that cutting tools of tungsten carbide in a bar that is properly piloted, will solve most of the difficulty.

The boring of the "cross-hole" or wrist pin hole in a piston is a job that has always been attended by a vast amount of grief. Features greatly to be desired in wrist pin holes are perfect roundness, finish, and alignment. The operation is usually performed by line reaming, although it is the writer's opinion that the hole should be bored. It most certainly can be bored to exact size and roundness without removing from the jig, if properly handled.

Figure 2 shows the general design of a fixture and boring tool that have been used with great success in the boring of the cross-hole. The cutter is tungsten carbide, set into a bar that is guided at both top and bottom by

revolving bushings. The use of such bushings makes it possible to fit the boring bar very close, as there is no danger from scoring. It will be interesting to the reader to know that more than 40,000 holes were bored with this tool before it required sharpening.

Another Method of Making a Conveyor Screw

I was greatly interested in Charles Kugler's description of a "Simple Method of Making a Conveyor Screw" which appeared in a recent issue of MODERN MACHINE SHOP. I believe a conveyor screw could be made easier and much better by chucking one end of a piece of Shelby tubing in a lathe and cutting through the wall with a parting tool. The lathe set to cut two threads per inch and a tool of ¼-in. width would produce a conveyor screw with equal wall thickness and a true inside diameter. Both of these features are difficult to obtain by the method described by Mr. Kugler.

I assume that the shaft diameter would be 2 in., and tubing with 4-in. outside diameter and 1-in. hole is carried in stock by most supply houses. It can be obtained in several different analyses and would have a uniform hardness that would be difficult to obtain in a piece of bar stock that was heated and hammered while being bent.—T. D. JOLLY.

Barber-Colman Offers Three Booklets On Gears

The Barber-Colman Company, Rockford, Ill., has issued three booklets which treat of the cutting of gears by the hobbing process, approaching the subject from several angles. The booklet, "Economical Hobbing," contains an explanation of the factors involved in getting the most satisfactory results, economically speaking, from hobbing machines. It discusses the selection of the machine, cost of maintenance, hob expense, bal-

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ancing of feeds and speeds, and other important factors. "Precision Hobbing" is a summary of the problems encountered in gear cutting where accurate work with good finish is required, and discusses details in the setting and operating of the machine for fine work.

The booklet, "Helical Gears," contains the results of an extensive investigation to determine the causes of inaccuracies in helical gears and means for producing helical gears that are consistently accurate. This booklet contains charts and data that have never before, so far as this company knows, been compiled. It is an unique presentation which casts the light of definite evidence into what has previously been a misty field of controversy.

These booklets are available, without charge, to mechanical executives who address their requests on their firm letter-heads.

Monarch Catalog of Model "C" Toolroom Lathes

The Monarch Machine Tool Co., Sidney, Ohio, has issued Catalog "C," which describes and illustrates the line of Model "C" Toolroom Lathes made by this firm. The catalog is 8½ x 11 in., and contains 24 pages of enameled paper, bound in a cover of bronze metallic paper. The book is remarkable both for the simplicity and conciseness of the text and for the quality of the illustrations—which are beautiful examples of photographic art.

Illustrations both of the assembled machines and of the various working parts are included, together with such views of the inspection operations as will give the reader a clear idea of the accuracy with which the machines are built. A copy of the catalog may be had by any mechanical executive who will address his request on his firm letter-head.

Diamond Flexible Coupling Catalog No. 11

Catalog No. 11 of Diamond Flexible Couplings has been issued by the Diamond Chain & Mfg. Co., Indianapolis, Ind. This 20-page book points out the simple construction features and ease of installation of Diamond Couplings, and illustrates and tabulates all the types and sizes in the line, together with data on selection and installation. Various types of drives with loads up to 700 h.p. are shown. Copy gratis upon request.

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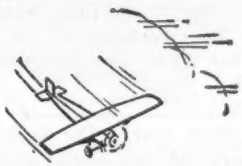

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Over the Editor's Desk

IT is a fortunate thing for the country that there are still some manufacturers and business men who are up and hustling instead of sitting back, singing the blues, and waiting for business to "come back." One of our representatives called on a client who is a tool manufacturer in the Detroit territory during the last week in May and found said client with his sleeves rolled up, busily supervising the redesigning of his product and getting out a new, elaborate catalog.

In response to a request as to the state of his business, he volunteered the information that he is sold on the country and its institutions from the president to the peanut vender on the corner, and that it is only a matter of time—and not so much time, either—until business in this country will be rolling along at a good, comfortable rate of speed.

The gist of his conversation was to the effect that there is nothing to be gained by sitting down and moaning about hard times; the thing to do is to improve the product so that the customer will get a real buy when he decides that the time is ripe for him to look, listen, and loosen. In accordance with this belief, our client is making improvements in the design of his product, making up a catalog, compiling a sales manual, and has laid out an advertising program so that when the sunshine breaks through the clouds, he will be all ready to make the well-known hay.

This seems to us like horse-sense, and we are passing it on to our readers for what they are able to get out of it.

THIS issue marks the fourth anniversary of the birth of MODERN MACHINE SHOP. Birthdays are useful things; they serve the double purpose of providing an excuse for a celebration and of serving as milestones by which the amount of progress made can be gauged.

Four years ago we took upon ourselves the task of providing the metal-working plant executives of this country with the best information available concerning the operation of machine shops of all kinds. The evidence, in the form of thousands of letters, inquiries, and requests for information, indicates that we have succeeded in our task. At the same time we have provided our advertisers with a medium through which they could place their sales announcements in the hands of practically every possible buyer of machine shop equipment in the United States and some of the foreign countries.

During these four years the plant owner, factory manager, engineer, superintendent, master mechanic, and foreman have found within these pages descriptions of plants, machines, tools, methods, and plant systems of all kinds, the information thus placed in their hands having been gathered from every state in the Union.

This excellent service has been made possible without charge to the reader through the co-operation and support of the firms whose advertisements have appeared within these pages. Thousands of our readers have indicated their appreciation, when answering advertisements or writing to manufacturers for information, by mentioning that they saw the advertisement or reference in MODERN MACHINE SHOP. To those who have reciprocated in this manner we wish to express our thanks. And to those who have overlooked this point, may we suggest that mention of MODERN MACHINE SHOP when writing to advertisers will be greatly appreciated both by the advertiser and by the publishers of this magazine.

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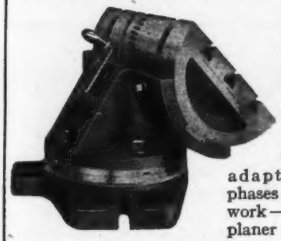

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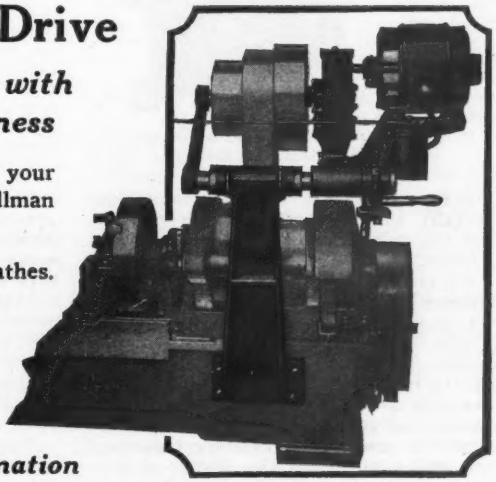

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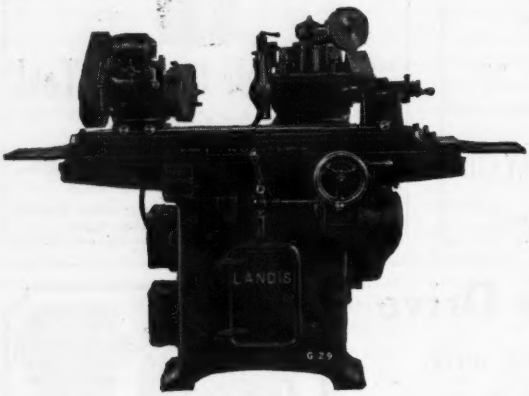
NEW SHOP EQUIPMENT

Landis 10 x 24-In. Motor-Driven Universal Grinding Machine

The 10 x 24-in. universal grinding machine shown in the illustration has been brought out by Landis Tool Co., Waynesboro, Penna., to fill the need for a universal motor-driven grinding machine for grinding light work. The machine is especially adapted for toolroom work, or for the needs of technical colleges and schools.



Landis 10 x 24-In. Motor-Driven Universal Grinding Machine.

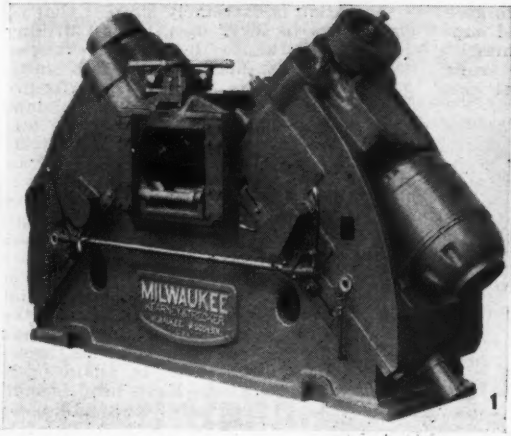
All controls on this machine are conveniently located. The traverse drive motor is mounted entirely within the bed, where it is protected from grit and water. The work drive motor is mounted on the headstock, while the wheel drive motor is mounted on the wheel base. The water reservoir is integral with the bed; thus the machine is entirely motorized and self-contained. The bed is of box-type construction.

The work carriage traverses on a V and a flat guide with chilled surfaces, covered at both ends. The drive from the traverse motor is by means of a flat leather belt, and a three-step cone pulley arrangement makes provision for three traverse speeds. The grinding wheel head is supported by a slide having a V and a flat guide with chilled surfaces. The wheel spindle bearings are of steel backed babbitt. The chrome-vanadium steel grinding wheel spindle is driven through a flat belt from an especially-balanced motor mounted on top of the base casting at the rear. Standard equipment includes 10 x ½ x 5-in. grinding wheel. The wheel head may be swiveled on its slide, thus permitting the wheel to be set at any desired angle without disturbing the direction of the feeding movement. The wheel can also be fed in different directions.

The headstock drive motor is mounted on a hinged plate, the position of which may be changed to maintain proper belt tension. Six work speeds are available. The spindle may be rotated, or may be locked for dead spindle grinding. It is also possible to swivel the upper portion of the head a full 90 degrees for face grinding.

The water pump is attached to a bracket inside the head, where it is driven through a flat belt by the work table traverse motor. A ball bearing type internal fixture is supplied, rigidly mounted on the front of the wheel head where it is driven by a flexible canvas belt from a pulley attached to the regular wheel spindle driving pulley on the motor. A hand reversing switch controls the direction of the motor rotation for internal grinding.

The net weight of the machine, without electrical equipment, is 3,050 lb. A 1-6 h.p. work drive motor, a ½ h.p. traverse drive motor, and a 1 h.p. grinding wheel motor, with their starting equipment, are attached to the machine before shipment.



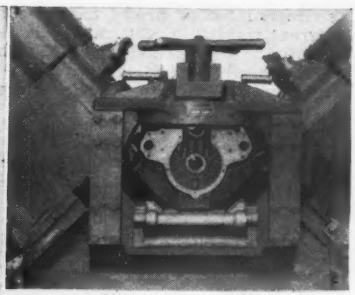


Fig. 1—Special Milwaukee Miller for Milling Exhaust Pads on New V-8 Cylinder Block. Fig. 2—Fixture in which block is located for milling. Six pads are milled, complete, in 40 seconds.

Special Milwaukee Miller for Milling Exhaust Pads on New V-8 Cylinder Block

The illustration shows a special six-spindle milling machine that has been designed and built by Kearney & Trecker Corporation, Milwaukee, Wis., for milling three exhaust pads on each side of the new V-8 cylinder block. The entire machine has been designed for the purpose of using tungsten carbide, although the plant schedule is such that the machine will first be run with Stellite; tungsten carbide can be applied at a later date if production warrants. Every part of the machine is ruggedly constructed, heavy in design, and built to deliver maximum production. It weighs, complete, 13,300 pounds.

There are two three-spindle heads, one at each side of the bed, mounted on angular slides so that they feed upward together and thus mill all six pads on the blocks simultaneously. Each head is driven by a 7½ h.p. 900 r.p.m. motor. Individual feeds to each head are available, although they are arranged to operate simultaneously at a feed of 15 in. per min. Feed changes are made by pickoff gears located between the motor and the flywheel.

All spindles are mounted in quills for individual adjustment to compensate for cutter wear, the adjustment being made by means of a crank and dial which is graduated in thousandths of an inch. Each quill is operated by a worm and bronze rack.

The cycle of the machine is entirely automatic. Both heads feed upward at 15 in. per min. until all pads are milled, when the feed is automatically disengaged and the heads reverse at a speed of 150 in. per min. The feed to the heads is by means of two large screws 3 in. in diameter, having a double ⅜ P. thread with ¾-in. lead. Both of the heads, as well as the fixture, are operated by dual control.

The machine is designed to be set into the production line so that the pieces enter the machine at one side and leave from the other. The fixture, shown in Fig. 2, is entirely of steel. The cylinder block feeds in on rollers to an approximate stop, is located by two disappearing dowels, and is clamped by means of a large 4-spoke handwheel.

Cored openings in the top of the bed and in the rear of the machine bed provide for chip disposal. Production is at the rate of 85 to 90 pieces per hour, or one finished block every 40 seconds.

Footburt 5-Way Drilling Machine

The Foote-Burt Company, Cleveland, Ohio, has developed a special 5-Way Multiple Spindle Drilling Machine that incorporates this company's latest developments in way drilling equipment. This machine has a total of 90 spindles and was furnished for drilling a V-type cylinder block. As will be seen from the photograph, the machine has one vertical head, two upper angular heads and two lower angular heads. It is of unit type construction, each drilling unit being complete within itself with individual motor drive. The frame of the machine

is constructed of heavy castings to give it great rigidity and furnish a solid support for the fixture and drilling units.

The heads are driven by the latest drum-type cam units, the vertical unit

Footburt 5-Way Drilling Machine.

and two upper angular units having 14-in. diameter cams and the two lower angular units having 10-in. diameter cams. In designing this machine the most suitable size of cam unit was used on each way. Due to the small number of spindles on the lower angular heads, it was possible to use a smaller unit than was necessary for the upper angular and vertical heads. The ways for these units are extra wide and the slides are very long to provide the necessary support for the units. It will be noted that all units are driven by standard foot mounted ball bearing motors so that the motors may be interchangeable, whether they are used on vertical, horizontal or angular ways. All heads and cam units have individual lubricating systems with sight feed gauges to show the level of oil in the units.

Operation is extremely simple; that is, one throw-in lever operates all drilling units and, due to the newly-developed throw-in mechanism of the cam units, this lever works easily. One fixture clamping lever clamps and locates the part and also moves the guide bushings in close to the work with a single operation. The throw-in lever starts the cycle of all units simultaneously and each unit continues through its cycle, returning to the starting point and remaining until the machine is unloaded and reloaded and the throw-in lever is again operated. Each head is individually adjustable on the ways to compensate for drill grinding, adjustment being by means of a crank which is used on squared shafts that are all placed down within easy reach of the operator.

The cam units used on this machine have the 10-in. and 14-in. diameter cams. The Foote-Burt Company also furnish cam units with 6-in. diameter cams and 16-in. diameter cams, providing a wide range of sizes to take care of various capacity requirements in designing way drills.

Excelsior No. 29 Straight Line Bumper Polishing Machine

The illustration shows the Excelsior No. 29 Straight Line Bumper Polishing Machine which is being built by the Excelsior Tool & Machine Co., East St. Louis, Ill., for the polishing of automobile bumpers. This machine is a redesign of the machine that was built by this company for the Ford Motor Company in 1926 when bumpers were first made standard equipment on Ford automobiles. The original straight-in-line polishing machine was capable of turning out 2,000 bumpers per day on one machine.

Bumper styles have changed recently to a wide oval or corrugated face with higher curves. Thus more lift and space

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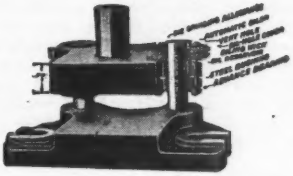

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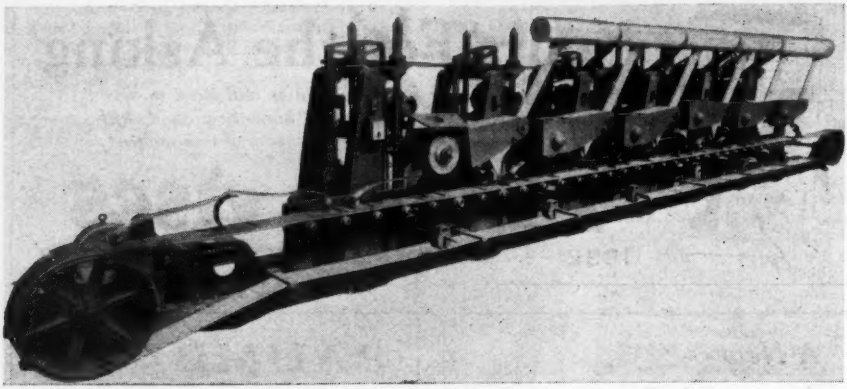
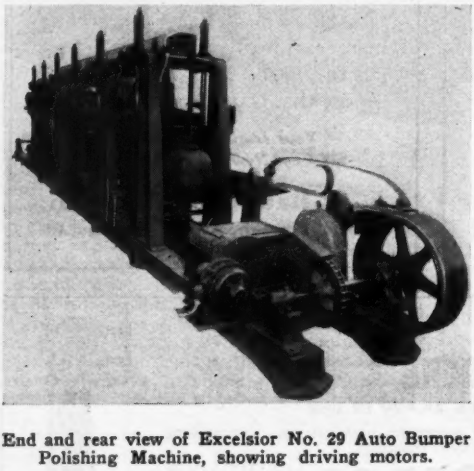


Front view of Excelsior No. 29 Automobile Bumper Polishing Machine.

between the conveyor belt and the polishing wheels is required to accommodate the higher curved bumpers, and the entire machine has been redesigned to minimize the wheel friction on the precipitous ascent of the wheel, as shown. The new design provides for a wheel rise of 12 in. The entire machine is of heavier construction, the heads are



End and rear view of Excelsior No. 29 Auto Bumper Polishing Machine, showing driving motors.

spaced farther apart, and the dust suction system has been improved and the capacity increased.

Each unit is equipped with a 10 h.p. motor, connected to the spindle by grooved pulleys and six V-type belts. Heavy balance weights are provided to prevent the polishing wheels from bouncing on the curves. Double dust spouts increase the protection against the dust hazard. Dust-proof ball bearings are provided on all equalizing connections. Power is transmitted to the belt conveyor through a Reeves adjustable speed transmission, making it possible to regulate the speed of the work past the polishing wheels.

The capacity of the 14-wheel machine is from 1,000 to 2,000 bumper bars per day, depending on the size and shape of the bumper. The floor space for a six-wheel machine is 6 x 48 ft., and the weight of this machine is approximately 25,000 pounds.

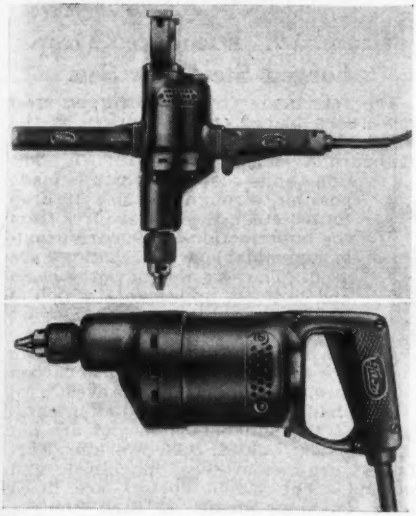
"Thor" 1/4-In. and 1/2-In. Universal Electric Drills

The Independent Pneumatic Tool Co., 236 South Jefferson Street, Chicago, Ill., is now manufacturing two new electric drills—a ¼-in. size with grip switch, to be known as the Type USA, and a ½-in. size with side switch, designated as Type URA. The drills are said to be exceptionally powerful, simple in construction, and with several new features of design.

The armature shaft for each type of drill is made from high grade alloy steel with pinions milled directly on the shaft. This construction prevents vibration. The armature core construction is of the

open straight slot type, which permits the use of separate form-wound coils that are laid into the slots without first being flattened. The omission of the flattening operation eliminates the possibility of injury to the wires—which is the cause of 90 per cent of armature trouble.

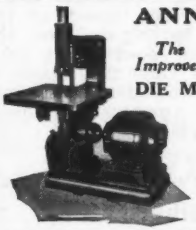
The commutator is made in one unit, independent from the shaft, and is balanced and tested at 1100 volts before being assembled to the shaft. Precision



(Above)—"Thor" Type URA ½-In. Universal Electric Drill. (Below)—"Thor" USA ¼-In. Universal Electric Drill.

ball bearings of the closed back type are used throughout. This type of bearing prevents the fan from sucking grease into the motor, and at the same time is subject to lubrication from the gear case because the open end of the bearing faces the gear case. The switch is of the double-pole type and breaks both sides of the line at the same time, thereby disconnecting the current from the line to the motor. The switch on the ¼-in. drill is operated by a long lever and is so arranged that it can be changed to either "safety first" or "positive" switch by pressing the lock button on the side of the handle.

The field case and handle are in one piece, made of aluminum. Both ends of the spindle are provided with oversize ball bearings, one in the centerplate and the other in the gear case, with the driving gear close to the centerplate



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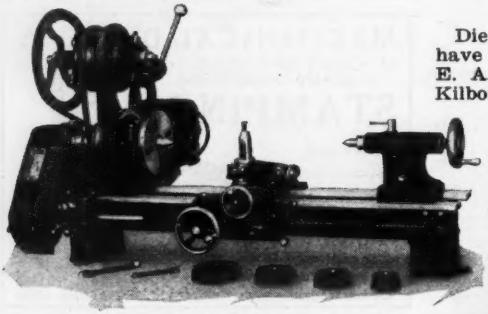
bearing, thus forming a rigid and vibrationless assembly. The speed of the USA (¼-in.) is 2,500 r.p.m., and the weight is 8 lbs. The speed of the URA (½-in.) is 500 r.p.m., and the weight is 14½ lbs. Equipment includes side switch, side handle, and combination spade handle and breast plate.

Atlas 9-In. Screw-Cutting Bench Lathe

The illustration shows the Atlas 9-in. screw-cutting bench lathe which has been placed on the market by the Atlas



Atlas 9-In. Screw-Cutting Bench Lathe.

Press Co., Kalamazoo, Michigan. Several new features are incorporated in the design of this machine, among which is the V-belt compound drive. With this drive the loss of power from slippage is reduced to the minimum. It also permits simple regulation of spindle speeds with the power off, eliminating the possibility of the operator having his hands or clothing caught by moving belts.

The Atlas lathe is a self-contained unit, the countershaft being mounted above the headstock with the motor mounted on brackets directly behind. The lathe is easily portable and may be set up anywhere where current is available. When the cord is plugged into a lamp socket, the lathe is ready for action.

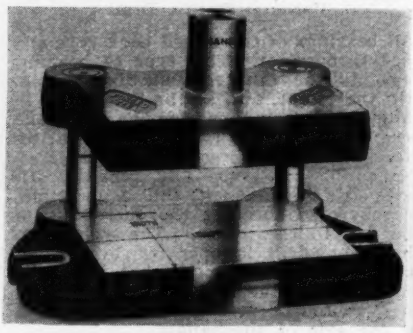
A complete set of gears is furnished, together with a chart showing the gears to use in cutting threads from 4 to 32 per in., including the 11½ P. pipe thread. Right or left hand feeds are obtained through shifting a lever. The headstock spindle runs in high speed bearings of the split type, easily adjusted for wear. Gibs on the carriage and compound rest permit compensation for wear on these parts. The compound rest and cross feed screw have collars graduated in thousandths of an inch. A ¾-in. hole through the spindle permits machining of bar stock in the independent or draw-in chuck. The tailstock may be set over for taper turning or boring.

The swing over the bed is 9 in.; swing over carriage, 6 in. Length of bed, 36 in.; capacity between centers, 18 in. Spindle nose has No. 3 Morse taper. Speeds in direct drive, 220, 370, and 600. Speeds in compound drive, 47, 80, 130. Weight, less motor, 145 pounds.

Baumbach Introduces Drop Forged Steel Die Sets

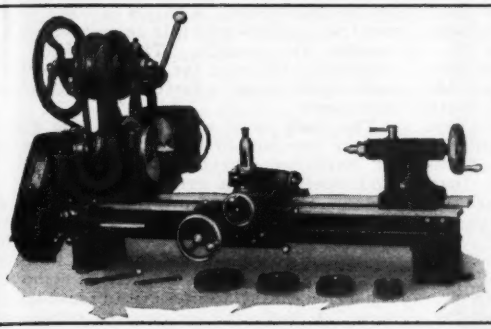
Die sets made from drop forged steel have been placed on the market by the E. A. Baumbach Mfg. Co., 1806 South Kilbourn Avenue, Chicago, Ill. In addition to the economy which is made possible through the use of drop forged steel, the sets are free from the imperfections which are usually unavoidable when castings are used. The sets also have the clean and uniform appearance which is possible where drop forgings are used.

All die shoes and punch holders are drop forged from 35-40 carbon steel, completely normalized. All shanks are drop forged as integral parts of the punch holders and are not inserted or welded. All working surfaces are accurately machined and ground. The punch holders are fitted with bushings made of high content manganese steel, each thoroughly car-



Baumbach Drop Forged Steel Die Set.

bonized, hardened, ground, and lapped to an individual fit on the leader pin of the corresponding die shoe. The leader



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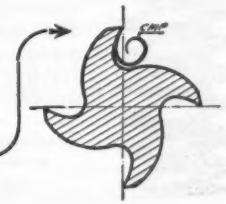

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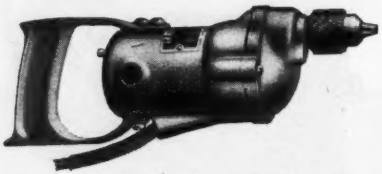
pins are hardened and ground so that they will withstand the friction and wear to which they are subjected.

The manufacturer states that not only does the use of drop forgings provide greater strength and durability with freedom from flaws and defects, but also that the shanks are unbreakable and the die shoes and punch holders are failure-proof. The die sets are lighter than heretofore, as heavy thicknesses are not required. A complete stock of the die sets is carried on hand.

U. S. "Midget" ¼-In. Drill

The United States Electrical Tool Co., 2471 West Sixth Street, Cincinnati, Ohio,



U. S. "Midget" ¼-In. Electric Drill.

has augmented its line by the addition of a ¼-in. electric drill to be known as the "Midget." This tool, which is shown in the illustration, is only 8 in. long without the handle—which is removable—and weighs 3½ pounds. The "Midget" is especially designed for light duty service and where close quarter operations are necessary.

The body is of aluminum. The gears are of the double reduction type, made of hardened chrome manganese steel, and operate in a grease-tight compartment. The tool is powered by a universal motor, and the spindle is fitted with a ¼-in. screw back chuck. The handle is bolted to the body in such manner that it can easily and quickly be removed when necessary to operate in close quarters. A 10-ft. rubber-covered cable and a soft rubber renewable attachment plug are standard equipment.

Mendes "D-P" Angle Diamond Dresser

The "D-P" Angle Diamond Dresser, made by Mendes Cutting Factories, Inc., 105 West 40th St., New York, N. Y., is said to present the diamond to the grinding wheel at the proper angle so that breakage of the diamond is prevented, the diamond is subjected to 25 per cent less wear, and a better job of wheel-dressing is obtained. Acting upon the

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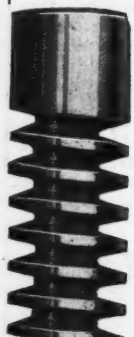

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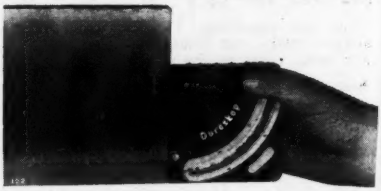

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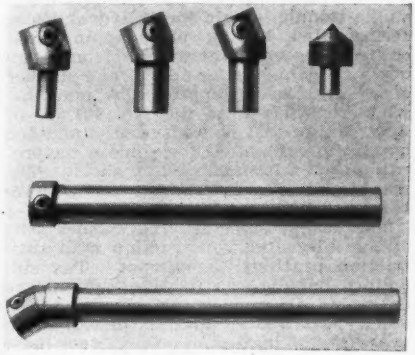
theory that the common type of diamond dresser presents the diamond to the wheel in such manner that the action of the wheel tends to pull the grain of the diamond apart, thus chipping, fracturing and softening the diamond so that it wears excessively, the "D-P" angle dia-



Mendes "D-P" Angle Diamond Dresser, consisting of diamond nib and shank for Heald, Landis, B & S, Norton, or Centerless grinding machine.

mond dresser is designed to present the diamond so that the wheel will strike it at an oblique angle. It is said that by contacting the wheel at an angle, the wheel strikes the diamond with the grain, resulting in a minimum of wear and heat.

Mendes "D-P" Angle Diamond Dressers are made in all styles necessary to fit the various types of grinding machines, as shown in the illustration.

"Modern" No. M31 Electric Tool Grinder

The No. M31 Electric Grinder which has been brought out by the Modern Grinder Mfg. Co., 110 South Second Street, Milwaukee, Wis., has a number of new and unusual features. The grinding wheels are mounted on a separate shaft instead of the motor shaft, power being transmitted from the motor to the wheel shaft by means of a V-belt. The wheels are easily accessible from all sides, and the V-belt drive is positive without exerting undue strain on the motor bearings. This construction also tends to protect the motor bearings from dust and grit.

The grinder frame is 13 in. long, 8 in.

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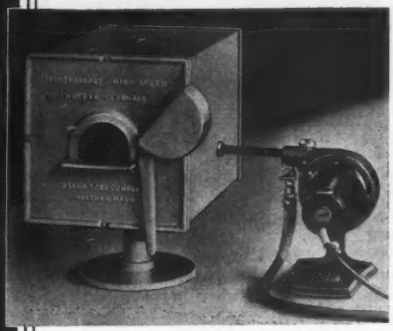

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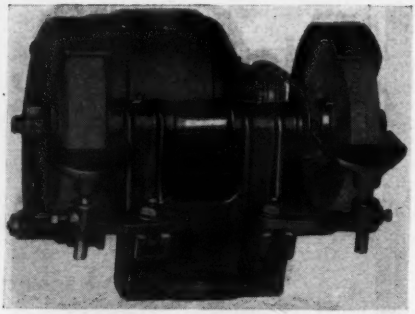

"Modern" No. M31 Tool Grinder.

wide and 9 in. in height. A detachable ¼ h.p. 1,725 r.p.m. 110-volt single phase A.C. motor is used, mounted on a sliding base to allow for belt tightening. Wheel guards are adjustable. Wheel speeds are 2,000 r.p.m. Equipment includes 10 ft. of cord with control switch in line, one medium and one coarse Dimo-Grit 6 x 1 x ⅝-in. wheel, wheel guards, tool rests, and self-closing oilers. Weight, packed for shipment, 70 pounds.

Barnes No. 194 Single Spindle, Single Speed Hydraulically Reciprocated Honing and Lapping Machine

The Barnes Drill Company, 820 Chestnut St., Rockford, Ill., has brought out a single spindle, single speed hydraulically reciprocated honing and lapping machine with which diameters from 4 in. down to ¾ in. can be honed, and smaller diameters can be lapped. The machine, which is known as the No. 194, is of light design and is built with simplified hydraulic equipment for spindle reciprocation, yet without dwell or shock. The machine has great utility for a wide range of light work.

The design embodies the Barnes self-oiling, all-geared construction with anti-friction bearings throughout. The six-splined spindle and its telescopic sleeve extension are made from chrome nickel steel, heat-treated and hardened. All gears are of high-grade alloy steel, heat treated. The spindle is driven by a six-splined hub running on 2 Timken roller bearings. The machine will be furnished geared to any one speed of spindle rotation desired, and the hydraulic control

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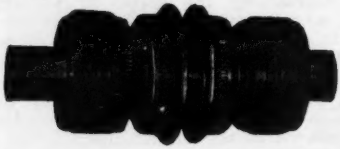

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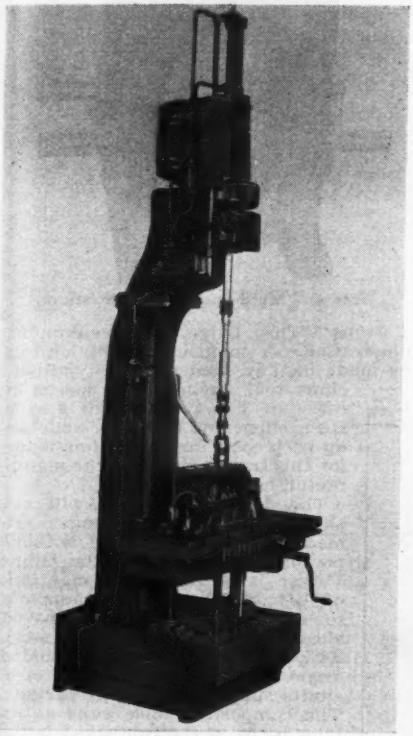
will be adjusted at the factory for one rate of spindle speed or reciprocation, the speeds being figured as best to suit the job.

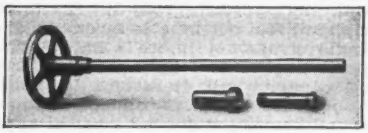
To facilitate lift-out, the spindle is equipped with a telescoping extension sleeve. The sleeve has approximately 5 in. of travel and may be locked at the upper position for honing out of work and locked at the lower position to prop-



Barnes No. 194 Single Spindle, Single Speed Hydraulically Reciprocated Honing and Lapping Machine.

erly locate the hone in the cylinder. The base contains compartments for a cooler reservoir and filter. The coolant pump is mounted in the column and is shaft-driven. The top of the base has covers for compartments with finished bosses upon which a fixture may be mounted. A solid box-type table can be supplied if desired.

The height of the machine is 112¾ in. and the distance from center of spindle to face of column is 10¼ in. Distance,



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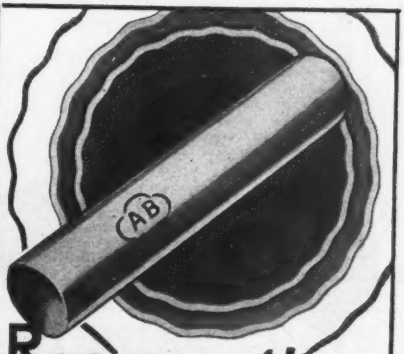

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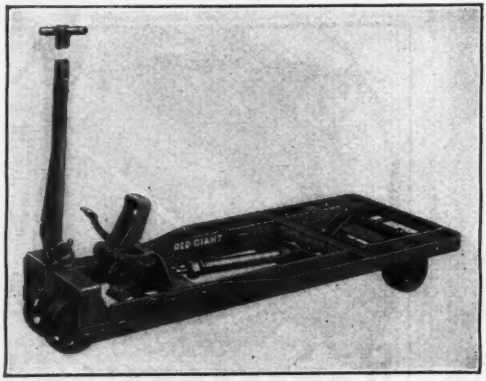
top of base to floor, 12¼ in. Spindle speed, any speed desired, but 200 to 300 peripheral feet per min. is recommended. Spindle stroke, ½ in. to 8 in. Honing capacity, ¾ in. to 4 in. diameter. Lapping capacity, all diameters too small for hone. Drive, direct-connected, standard ball bearing motor for vertical application; 2 h.p., speed of 1,800 r.p.m. recommended. Floor space required, 34 x 28 inches.

"Red Giant" Double Stroke Lift Truck

The Revolvator Company, 350 Garfield Avenue, Jersey City, N. J., has placed on the market a double stroke lift truck which has all the features of the single stroke truck with the added advantage of the double stroke. The double stroke divides the effort required to lift a given amount of load; thus a 5,000-lb. load can be raised with the same amount of effort as would ordinarily be required to raise 2,500 lb. if a single stroke truck were used. The construction of the "Red Giant" double stroke truck requires but one more part than is required in the construction of the single stroke truck.

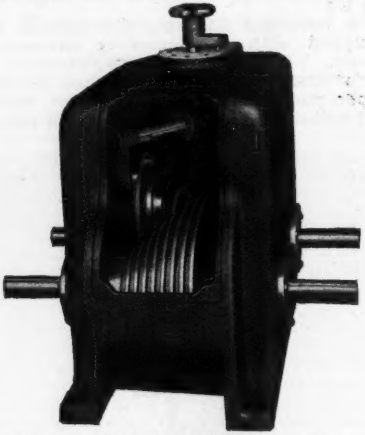


Red Giant Double Stroke Lift Truck.

The truck is made in the same sizes as the "Red Giant" Stand Model H, for 2½-in. lift only.

General "Multi-Speed" Transmission

The General Radial Drill Co., 1765 Elmore Street, Cincinnati, Ohio, announces a line of "Multi-Speed" speed change boxes for application to machine tools, especially where the machine tool is to be motorized. The drive is made through



General "Multi-Speed" Transmission.

a Gibbs V-Disc Drive, as shown in the illustration. A compact installation can be made on any kind of cone-type machine tool, giving eight speeds in ratios of 3 to 1, 5 to 1, or 9 to 1. High efficiency, long life, and low up-keep costs are the claims made for this transmission by the manufacturers.

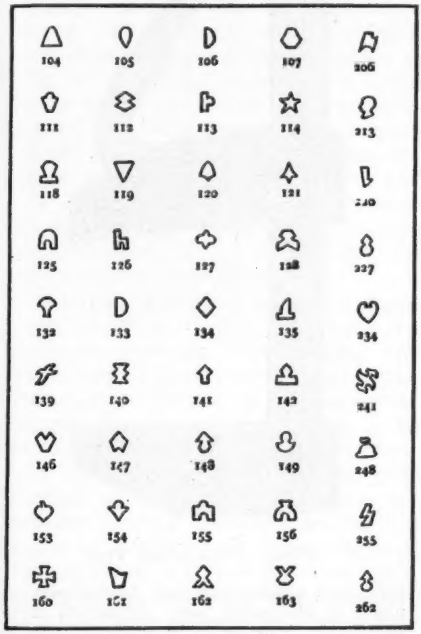
The drive is positive, will not slip, and its speed changes are made simply, easily, and without possibility of injury. The Gibbs V-Disc is of fabricated material, of ¼-in. thickness and diameters to suit. The cones or grooved sheaves are of high carbon steel, with grooves of 24 deg. included angle, and are mounted on steel shafts supported by ball bearings. The composition disc runs as an idler between the cones and is the only part to wear excepting the ball bearings. The transmission proper runs dry. The shaft ball bearings are the only points for lubrication, and these are lubricated from the outside.

The multi-speed transmission may be run in either vertical or horizontal position. It is totally enclosed, very quiet, easy to apply and simple to operate.

Schwerdtle Steel Code Stamps

A series of steel stamps bearing symbols with which manufacturers can have their products stamped to indicate

results of inspection, or to indicate the inspector who made the tests, or for any other purpose, can now be obtained from The Schwerdtle Stamp Company, 10 Cannon Street, Bridgeport, Conn. The



Drawing showing some of the 210 standard symbols on the steel stamps made by The Schwerdtle Stamp Co.

illustration shows some of the 210 stock symbols made by this company, although special symbols can be made to order.

Steel stamps carrying such symbols are used in many plants for the inspectors to use to stamp work after inspection, thus indicating that the work has been inspected and identifying the inspector who examined it. Special symbols can be used as a code to indicate variations in the quality of the product or for other similar purposes. Products can be graded in this manner, or marked to indicate the date of manufacture, or to indicate the grade of the materials used in the manufacturing process.

Each die is made from high grade tool steel, properly heat treated. A complete catalog of designs can be had by applying to this firm as above.

"Flash" C-Clamp

The Climax Equipment Co., 5514 West Lake Street, Chicago, Ill., has placed on the market a quick-acting C-clamp, to be known as the "Flash." The clamp is made with one solid jaw and one sliding jaw, the latter carrying a lever by which it can be released or clamped in position instantly. As the lever is moved away from the connecting bar, an auxiliary jaw is forced out to take up any play and assist in clamping. The

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THE Springfield Straightening Press is the ideal tool for straightening any length of rough or finished work—truing sprung tools—testing and balancing cams, or crank shafts—and scores of other jobs.
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DETROIT

clamp is also intended for use as a drill press vise. Both jaws are of nickel cast

"Flash" C-Clamp and Vise.

iron, the connecting bar being cast in place in the solid jaw. Standard sizes are 6 in., 12 in., and 18 inches.

Keeping Tabs on Purchases

(*Continued from page* 16)

nancial factors will be computed more carefully and taken into account in determining the inventory total during various periods of the year. There is a definite relationship between inventories and gross sales, and in an evenly balanced business this factor should be fairly stable.

Similarly, there is a close relationship between gross profits and inventories. If gross profits are abnormally high during any period and cannot be accounted for by unusual profit-making conditions during the period, then there is a probability of overstatement of inventory values.

Manufacturing Refrigerator Parts

(*Continued from page* 11)

boring machine, in an operation which includes the boring of two holes in a cylinder and one hole in a crankcase cover. The cylinder, rod, and cover are clamped into a jig as shown in Fig. 9, and the five holes are bored at a single operation. A carboloy-tipped tool is used, running at a speed of 255 ft. per min. The holes are finished to size within 0.00025 in., and the production is 40 pieces per hour of each kind. Each tool will bore approximately 350 holes before the tool requires re-lapping.

Another interesting set-up of equipment is shown in Fig. 10, where the tools for forming and seaming the evaporator sleeve can be seen. The sleeve, when formed, is of rectangular shape with round corners, and is 16 in. long and 8 x 6 in. in diameter. The sleeve has been blanked and formed at the ends in a previous operation. In the operation shown, the sheet is slipped into place between the pressure pad and the horn of a seaming die, as shown, with the ends of the piece resting on the wings which project from each side of the die. Stop-pins at each side locate the piece properly.

As the ram descends, the wing at the front swings upward into position at the end of the horn, to support it, and the wings at the sides rise to wrap the piece about the horn. This movement brings the ends of the piece together over the slot in the top of the horn so that, as the ram finishes the down stroke, it flattens the seam and presses it into the slot so that the sleeve will present a smooth surface on the outside. On the up stroke, the horn rises again to loading position and the wings open outward so that the piece can be removed from the horn.

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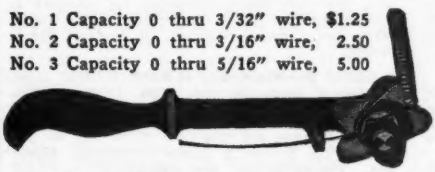
No. 2 Capacity 0 thru 3/16" wire, 2.50
No. 3 Capacity 0 thru 5/16" wire, 5.00



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Check any of these useful publications that you want, write your name, firm name, title, and address on the margin, then tear out the page and send to Modern Machine Shop, 128 Opera Place, Cincinnati, Ohio. They will be forwarded to you promptly without cost or obligation. Please restrict your list to not more than ten.

Cut Your Sawing Costs: "Lenox" hack saw blades and band saws are guaranteed to effect savings on your sawing operations. Write for information to American Saw & Mfg. Co., Springfield, Mass.

Ames Gages: Catalog No. 50, issued by the B. C. Ames Company, Waltham, Mass., contains complete descriptions and illustrations of the dial gages, gage heads, upright gages, cylinder gages, dial micrometers, and precision verifiers, special gages and attachments made by this company. Copy free upon request.

Scraping By Power: Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

"Atlas" Bench Lathe: A 9-in., screw cutting, self-contained, motor-driven bench lathe is now being built by Atlas Press Co., Kalamazoo, Mich. Write for circular.

Greenerd Arbor Presses: Catalog No. 36, issued by the Edwin E. Bartlett Co., Nashua, N. H., describes and illustrates all the various types and sizes of arbor presses made by this firm. Copy free upon request.

Drop Forged Steel Die Sets: The economy and other advantages of drop forged steel die sets, which are now being made by E. A. Baumbach Manfg. Co., 1806 South Kilbourn Avenue, Chicago, Ill., are explained in a folder that can be had by addressing this firm.

Abrasives: Samples of "Aloxite" Brand "TP" Polishing Grains for trial may be had without charge by addressing the Carborundum Co., Aloxite Division, Niagara Falls, N. Y.

Mounted Grinding Wheels for use in small holes such as are found in bushings, dies, gears, tools, etc., are described in a catalog that has been issued by the Chicago Wheel & Manfg. Co., 110 S. Aberdeen St., Chicago, Ill. Copy free upon request.

Flexible Couplings in which there are no screws, no bolts, no grease, no projections, and which run as smooth as a pulley are described in Bulletin 103-B, which can be had by addressing The Clark Controller Co., 1146 East 152nd Street, Cleveland, Ohio.

Motorize Your Cone Pulley Lathes: An attachment that can be applied to your lathe with four bolts makes it possible to motorize and modernize your lathes. Write for information to Cullman Wheel Co., 1336 Altgeld St., Chicago, Ill.

Die Makers' Supplies: A complete line of die sets, leader pins, bushings, and other die makers' supplies are described in a book that is issued by the Danly Machine Specialties, Inc., 2104 South 52nd Avenue, Chicago, Ill. Sent free upon request.

Steel Spacing Washers: Milling jobs can be set up quicker by using standard spacing washers, made by Detroit Stamping Co., 3445 West Fort Street, Detroit, Michigan. Write for information.

Interchangeable High Production Tools: Catalog No. 32, issued free by Eclipse Counterbore Co., 7410 St. Aubin St., Detroit, Mich., describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

"Speed" Spot Welders for welding metals from 0.0005 in. to 5/8 in. thick are described in a catalog that can be had by addressing Eisler Electric Corp., 761 South 13th Street, Newark, N. J.

The Involute Gear Simply Explained: A direct, clear explanation of the theory and principles of involute gearing without the use of higher mathematics can be obtained without charge by addressing The Fellows Gear Shaper Co., 78 River St., Springfield, Vt.

Performance Data On Swiss Jig Borers: This 36-page pamphlet shows various types of jobs from a power shovel turntable jig to a television disc, drilled and bored on Societe Genevoise High Speed Precision Borers, giving data as to size of holes, accuracy and time savings. Free upon request to The R. Y. Ferner Co., 1008 K Street, N. W., Washington, D. C.

Questions To Ask Before Buying a Jig-Boring Machine: A list of the fine points to look for in a jig-boring machine, with descriptions and illustrations of the working parts of the Swiss Jig Borer, can be obtained free by addressing The R. Y. Ferner Co., 1511 K St., N. W., Washington, D. C.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out, cutting and using gears. Sent free by Formica Insulation Co., 4632 Spring Grove Avenue, Cincinnati, Ohio.

Stampings of any kind or size can be obtained from Gerding Brothers, 5 East Third Street, Cincinnati, Ohio. Write for particulars.

Ball and Roller Bearings, either journal or thrust, for all purposes and in all sizes, are described and illustrated in catalog No. 9 which has been issued by The Gwilliam Company, 360 Furman Street, Brooklyn, N. Y. Copy free upon request.

Precision Bench Lathe Work can only be done on finely-built, accurate machines. The complete line of Hjorth Precision Bench Lathes is described and illustrated in a catalog that has been issued by Hjorth Lathe & Tool Company, 60 State Street, Boston, Mass. Copy free upon request.

Pyrometers: Inexpensive portable and stationary, single unit and multi-circuit pyrometers are described in a catalog issued by Illinois Testing Laboratories, Inc., 146 West Austin Avenue, Chicago, Ill. Copy free upon request.

Special Mil-Waukee-Mils of Standard Units: A milling machine of which the base, heads, columns, and other parts are built in standard units, thus enabling the user to order a machine that will be especially adapted for his job, is described and illustrated in Catalog No. 36, issued by the Kearney & Trecker Corporation, Milwaukee, Wis. Free to machine shop executives.

Threading Machinery: Catalog No. 32, containing full descriptions of Landis threading machines, stay bolt threading machines, bolt factory threading machines,

automatic forming and threading machines and chaser grinders can be had without charge by addressing Landis Machine Co., Inc., Waynesboro, Penna.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Save Your Diamonds by using the Diamond Point Angle Tool. Write for information to Mendes Cutting Factories, Inc., Charlevoix Bldg., Detroit, Mich., or 105 West 40th Street, New York, N. Y.

Monarch Toolroom Lathes: Catalog "C," issued by The Monarch Machine Tool Co., Sidney, Ohio, describes and illustrates the line of toolroom lathes made by this firm. Copy free on request.

Compound Spot-Facing Tool: A spot-facing tool retracting, serrated roughing cutters and fixed finishing cutters in the same tool will break up the scale easily and do accurate work. Write for bulletin to Mummert-Dixon Co., 120 Philadelphia St., Hanover, Penna.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

"Commercial Lapping for Close Limits and High Production" is the title of a booklet that discusses hand and machine lapping, types of lapping tools and machines, workholders for machines, preparation of laps, preparation of work for lapping and other important points. A copy may be had by addressing Norton Company, Worcester, Mass.

Die Making Machines: How dies, templates, gages, etc., can be sawed out, filed, and lapped easily and accurately on Oliver die making machines is fully described in a bulletin issued by the Oliver Instrument Company, 1430 Maumee Street, Adrian, Mich. Mailed upon request.

Good Vises Breed Good Work: Good bench work is impossible with badly-made or worn-out vises. The seven outstanding features of the Parker Vise are described in a bulletin that can be had by addressing The Charles Parker Co., Meriden, Conn.

Good Gears of all kinds—spur, spiral, bevel, worm, hypoid—in fact, any kind or type of gear desired, large or small, machined to an excellent finish and the highest degree of accuracy, may be obtained from Perkins Machine & Gear Co., 151 Circuit Ave., Springfield, Mass. Write for estimates.

Bench Lathe Mounting and Driving Equipment: Bulletin 120-A, issued by Rivett Lathe and Grinder Corporation, Brighton, Mass., contains complete descriptions and illustrations of modern and conventional countershaft, individual motor drive jackshaft, and speed box motor drive, also benches, cabinets, oil pans, etc. Copy free upon request.

Fullmore Industrial Clutch: A multiple disc clutch, made in two types, to run in oil or dry, and which is so built that it can be operated at high speeds, is illustrated and described in a folder that will be sent free by the Rockford Drilling Machine Company, Rockford, Ill.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Steel Stamps and Marking Dies: Full information as to steel stamps, steel roller dies, embossing dies, and embossing rolls made by the Schwerdtle Stamp Co., 10 Cannon Street, Bridgeport, Conn., can be had by writing this firm.

Economies in Material Handling: A volume of facts about planned load handling, with actual examples of economies in time, material, and labor costs that have been effected with Shepard electric hoists will be sent free upon request to Shepard-Niles Crane & Hoist Corp., 424 Schuyler Avenue, Montour Falls, N. Y.

The Most Efficient Speed for the operation of special production units, power conveyors, and other machinery by the use of the WHS Speed Reducer and how it can be obtained is told in a bulletin that will be mailed free by Winfield H. Smith, Inc., 30 Eaton St., Springville, N. Y.

Speed and Accuracy in Straightening: The Springfield Straightening Press is an ideal tool for use in straightening any length or size of rough or finished work. Send for illustrated folder. Address The Springfield Machine Tool Co., 630 West Southern Avenue, Springfield, Ohio.

"Stark" Motor Drive Unit: A motor drive unit for use with bench lathes, bench millers, and other machines operating on ½ h.p. with a variable speed reduction gear is described in Bulletin "F," issued by Stark Tool Co., Waltham, Mass. Copy free upon request.

Cutting and Grinding Facts: A discussion of cutting oils and lubricants, together with descriptions and illustrations of various kinds of jobs upon which cutting oils are used, is contained in a booklet that is issued by the Sun Oil Company, 1608 Walnut Street, Philadelphia, Penna. Free upon request.

Tips for Torches: Standardized cutting and welding tips that are interchangeable with various types of torches are now available. Write for catalog to Tips, Inc., 515 Cathedral Street, Baltimore, Md.

Chuck With Air: How time and labor can be saved by the use of air-operated chucks, cylinders, and other equipment is told in a book which describes "Hopkins" Air-Operated Equipment. Published by The Tomkins-Johnson Company, 620 N. Mechanic St., Jackson, Mich. Sent free upon request.

Change drilling speeds instantly without stopping the machine or touching a belt. This can be done with the Victor Super-Drill, made by U. S. Automatic Box Machinery Co., Newtonville, Boston, Mass. Bulletin free upon request.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 29, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

Double-Life End Mills: Weldon Double-End Type End Mills, made with blades on each end, are described in Catalog No. 6, issued by The Weldon Tool Company, 1426 West Third Street, Cleveland, Ohio. Other small tools made by this firm are also described and illustrated in this catalog.

Shop Furniture: A catalog describing and illustrating all kinds of shop furniture, including benches, vises, steel stands, foremen's desks, chip trucks, steel racks for bar stock, steel tote boxes, and other equipment will be sent free upon application to The Western Tool & Manufacturing Co., 1620 East Pleasant Street, Springfield, Ohio.

Wrenches For Every Use: "Guaranteed Against Breakage" tappet wrenches, pipe and fitting tongs, offset wrenches, and wrenches for all other uses are described and illustrated in a series of folders which can be obtained without charge by addressing J. H. Williams & Co., Buffalo, N. Y.

Index to Advertisements

A — Page

American Saw & Mfg. Co..... 23
Ames Co., B. C..... 41
Anderson Bros. Mfg. Co..... 27
Armstrong Bros. Tool Co..... 6
Atlas Press Co..... 43

B

Bartlett Co., Edwin E..... 51
Baumbach Mfg. Co., E. A..... 39

C

Carborundum Co., The..... 15
Chicago Wheel & Mfg. Co..... 43
Cullman Wheel Company..... 35

D

Danly Machine Specialties, Inc.... 19
Detroit-Leland Hotel 50
Detroit Stamping Company..... 32

E

Eclipse Counterbore Company.... 33
Eisler Electric Corporation..... 39

F

Fellows Gear Shaper Co., The.... 17
Ferner Co., The R. Y.....23, 44

G

Gerding Brothers 41
Gwilliam Company, The..... 23

H

Hjorth Lathe & Tool Co..... 51
Hollenden Hotel 50

I

Illinois Testing Laboratories, Inc.. 47

J

J. & H. Electric Co..... 43

K

Kearney & Trecker Corporation.. 1

L — Page

Landis Machine Co., Inc..... 2
Logansport Machine Co., The, Second Cover

M

Mendes Cutting Factories, Inc.... 35
Monarch Machine Tool Co., The... 55
Mummert-Dixon Co. 51

N

National Automatic Tool Co., Third Cover
Norma-Hoffmann Bearings Corp.. 4
Norton Company 3

O

Oliver Instrument Company..... 41

P

Parker Company, The Charles.... 39
Perkins Machine & Gear Company 44

R

Rivett Lathe & Grinder Corp..... 47
Rockford Drilling Machine Co..... 46
Ruthman Machinery Co..... 46

S

Schwerdtle Stamp Company..... 47
Shepard Niles Crane & Hoist Corp. 56
Smith, Winfield H., Inc..... 39
Springfield Machine Tool Co..... 49
Stark Tool Co..... 45
Sun Oil Co.....First Cover

T

Tips, Inc. 49
Tomkins-Johnson Company 27

U

U. S. Automatic Box Mch'ry Co... 35
United States Electrical Tool Co., The .....Fourth Cover

W

Weldon Tool Company, The..... 43
Western Tool & Mfg. Co., The.... 27

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Made in four sizes—13", 16", 18" and 20"—the Monarch Model "C" Tool Room Lathe is regarded as the very finest precision lathe of today.

Few concerns give tests as severe as this one before marking a machine tool OK.

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Bulletin No. 164 pictures some of these tests. Write for a copy.

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Helical Gears - Timken Bearings

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This is possible because of mass production methods, which Shepard can apply to a degree unapproached by any other hoist builder. Shepard "unit construction" is particularly adaptable to quantity production. And, in addition, Shepard sells nearly as many hoists as all of the other manufacturers combined.

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When you are considering hoists—don't fail to get the proof that you pay *no price premium for the better performance of a Shepard.* The coupon brings the facts, or if you prefer, an informative booklet on Shepard Hoists.

Only Shepard can give you these features

1. *Balanced Drive, at two points diametrically opposite*
2. *Perfect alignment, maintained by all moving parts rotating around a common axis*
3. *Automatic Oil Bath Lubrication*
4. *Controlled by rope, push button or outrig for every hoist*
5. *Precision variable speed control for both A.C. and D.C.*
6. *Variety of speeds, types, lifts and capacity precisely suited to any specific service*

SHEPARD
CRANE & HOIST DIVISION

SHEPARD NILES CRANE & HOIST CORPORATION, 424 Schuyler Ave., Montour Falls, New York

☐ *Send booklet on Shepard Electric Hoists*

☐ *Send representative to prove that a Shepard costs no more—we are in the market for a hoist*

*Name*_____ *Company*_____

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(Patented)

NATCO UNIVERSAL JOINTS for MACHINE TOOLS and OTHER COMMERCIAL APPLICATIONS

The NATCO Patented Universal Joints are made of alloy steel, heat treated, hardened and ground. They are fulfilling the requirements of many manufacturers who demand a compact joint, built with precision, insuring perfect balance, durability and maximum strength.

NATCO joints are constructed of a multiple of but three distinct parts, namely: one center block, four identical drive sides and two identical short ends. The center block contains a lubricating feature which keeps the trunnions lubricated and is machined from a solid block of steel, thus eliminating the chance of trunnion pins working loose.

NATCO joints are built in eight different sizes, ranging from ⅝" up to and including 3" in diameter. Write for complete information.

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SOLVES YOUR 'HOLE' PROBLEM

"NATCO Solves Your 'Hole' Problem"

THE NATIONAL AUTOMATIC TOOL CO.

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Announcing!

the MIDGET

¼ INCH DRILL

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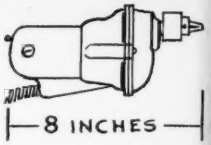
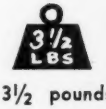
HERE is the handiest and most compact drill ever made! And think of it—at the ridiculously low price of $23.00. The new U. S. Midget weighs only 3½ pounds and is just 8 inches long. It is easy to carry—easy to handle—and can be operated in exceptionally close quarters. It has an aluminum body, and double reduction, hardened chrome manganese gears, which operate in a grease-tight compartment. A Universal Motor is used and it is furnished with a ¼" screw backchuck. The handle is securely bolted to the body, but can be readily removed when necessary. Ten feet of rubber covered cable and a soft rubber renewable attachment plug are standard. Return the coupon below for further particulars.



Imagine how handy it would be to have a drill only 8 inches long. That's the size of the new U. S. Midget.



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